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THE GEOGRAPHY
OF COMMERCE

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THE GEOGRAPHY OF COMMERCE

BY

W. P. RUTTER, M.Com.

PRINCIPAL, BYROM STREET DAY CONTINUATION SCHOOL, MANCHESTER
LATE LECTURER IN ECONOMICS AND COMMERCIAL GEOGRAPHY
MUNICIPAL HIGH SCHOOL OF COMMERCE, MANCHESTER

AUTHOR OF "WHEAT GROWING IN CANADA, THE UNITED STATES AND THE ARGENTINE," ETC.

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PREFACE

THE object of this book is to give a broad survey of Commercial Geography, and to show, though imperfectly, its "soul" and its deep and abiding truths. If this has been attained, my efforts will have gained a rich reward. I hope that teachers, students in the universities and the higher commercial schools, and the general reader may find in its pages much that is thought-provoking and stimulating to the imagination.

My indebtedness to many inspiring writers in the fields of Geography, Biology, Psychology, and Sociology is very great; and especially am I indebted to the late Professor Herbertson, Professor J. Arthur Thomson, Professor Lyde, Professor Fleure, Professor Patrick Geddes, Professor R. S. Lull, Dr. Hardy, Dr. Newbigin, and Miss Semple. To all I am most grateful. It is a very pleasing duty also to thank the many earnest students, to whom I have had the good fortune and pleasure to lecture, for the spur they gave me which caused me to seek for the inner truths. Several of the maps have been drawn by my colleague, Mr. John Bennett, to whom I tender my sincere thanks.

Geography is now humanistic, and is destined to rank among the foremost of educational subjects. It is gaining much from the biological and sociological sciences, and will, with their aid, pour much light not only upon the material but also the spiritual side of man.

Students will find that they will derive the greatest benefit by working always with a good economic atlas, such as that of Bartholomew and Lyde; and they are advised to seek for the statistics they need in the official *Statistical Abstracts* and the

Statesman's Year Book. The bibliography should be consulted by those who wish to delve more deeply.

In conclusion, I trust that my readers may find as great a joy in reading as I have in writing the book.

WILLIAM P. RUTTER.

MANCHESTER.

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THE GEOGRAPHY OF COMMERCE

CHAPTER I

THE BASES OF COMMERCIAL GEOGRAPHY

> "Living is a twofold relation between organisms and their environment—a twofold relation of action and reaction, of thrust and parry, of doing and suffering."—*J. Arthur Thomson.*

GEOGRAPHY is the science which deals with human efforts in relation to the environment in which human life is passed. Perhaps, of the many branches of this wide subject, the commercial is the most fascinating and essentially human, for, in its fullness, it is a deep study of the interaction of Man and Nature as seen in the production, transportation, and consumption of economic products. The work of the earth in supplying man with the economic products which satisfy his physical wants—food, clothing, and shelter—and man's modifying actions on his surroundings are clearly set forth; and progress into the "soul" of the geography of commerce is gained only by the full recognition of environment as a living, active, stimulating and discriminating factor in the world. All life is a compromise of movement and stability, of variation and unification under environmental pressure.

THE HOME OF MAN.—During countless ages the illimitable Power prepared the earth to be the home and mother of man. The Divine Energy shaped the electrons by the million billion out of some fundamental stuff; gave them impulses of tremendous potency; constituted with them atoms; grouped the atoms into molecules, and the molecules into colloidal substances; nurtured and fecundated them by cosmic energies; originated life; and in man developed thought, mind, and ideals. Man is part of a creative destiny, reaching backward and forward to infinity; he is the fruition of a process stretching back to star dust; he is the material in the Creator's hands for a still larger destiny in the infinity of time.

Economic man, the highest type of visible life, is but a product of the earth's surface, the child of mother earth, and dust of her dust. She tends him, shapes him, enters into his bone and tissue, and penetrates his very mind and soul. In the rich river valleys the fertile soil induces him to become sedentary, peaceful, agricultural, persevering, and patient ; the nature of the cultivator is, therefore, one of construction and development, idealizing peace. In strong contrast the inhospitable conditions of barren mountains and cheerless steppes implant a fighting and adventurous spirit in the hardy mountaineer and the lean nomad, making them frequently conquerors of the settled peoples. In arid lands, man is confronted with irrigation problems ; in tropical tracts, with forest, race, and disease problems ; while seas, oceans, and mountain barriers give him navigation and engineering problems. These he solves, in part, by earth-whispered hints for their solution. Nature has polished the mirror of his mind, and the polishing still continues. The pastoral nomad, accustomed to vast and monotonous surroundings, to solitude and contemplation, unlike the death-dealing hunter, idealizes life, venerates tradition, and respects age and experience. To him is assigned the first belief in the one Shepherd God, and world environment has widened his monotheistic religion into the noble ideal of charity.

MAN'S ENVIRONMENT.—Man's relations to his environment are far more numerous and complex than those of the most highly organized animal or plant. Mountain ranges and high plateaux act as barriers to his trade, the intermingling of nations, and the spreading of ideas, but by the wealth within them and their water-power they aid his mining and manufacturing industries. Dry deserts, preventing stimulus from outside sources, produce the fanatic robber nomad with a small migratory farm. Favoured valleys and plains, furnished with fertile soils, adequate water-supplies, mild climates and easy routes, saw the first civilizations arise ; while seas and oceans have been, and are, both outlets and barriers to the spread of culture. The great traders of the world inhabit countries possessing extensive coast lines in comparison with their areas, and continental islands surrounded by shallow seas where the tides rise high.

Geography and History. An intimate connection exists between geography and history; the former deals with existence in various regions of terrestrial space, while the latter considers human events in various periods of time. Geography supplies the space element, and history contributes the time element in man's evolution. History may, therefore, be considered as "geography set into motion." Trade centres, cities or "con-urbations," studied environmentally, become dramas in time and space, and full comprehension of the commercial, economic, and intellectual progress of nations is impossible without a study of their history. As the earth is one, so is humanity, and each country, continent, sea or ocean, is physically and historically intelligible only as a portion of the whole earth. Geographical problems must be viewed in the big perspective of evolution and the historic past. They need allowance for the dominance of different geographic factors at different periods, and for a vast range of geographic influences earth-wide in their scope.

Climate. Through aeons of time climate has been a potent force, and her power is ever evident in the evolution of society. Subtle is her influence, and without a knowledge of her workings the history of civilization cannot be understood. She fixes the boundaries of human habitations in high latitudes and altitudes by prohibiting the presence of almost all forms of life; dominates life in the steppes, torrid deserts, and polar wastes; underlies the production of economic commodities derived from the vegetable and animal kingdoms; governs methods of agriculture; and affects the efficiency of human labour in various industries. The effects of climate upon man are, as yet, only imperfectly known; but though his mobility, mental ability and inventiveness enable him to emancipate himself from the full force of climatic control, he is, nevertheless, directly and indirectly her subject. She dictates what crops he may raise; radically affects the size of his harvests; decides what flocks and herds are best suited to his environment; aids him in his manufacturing industries; and increases or limits his energy. In the warm Miocene epoch luxuriant forests covered a large part of Eurasia, and in these forests Simiidae abounded. In succeeding Pliocene and Pleistocene times the climate became colder, glaciers covered the mountains, and the forests receded and were replaced by steppes over which roamed myriads of grazing animals. Under these circumstances the more progressive Simiidae descended from the trees, formed troops to chase the smaller animals of the plain, and so the ground-ape, man, evolved—a product of the Glacial Epoch. It is noteworthy that only in the North Temperate Zone has man attained his fullest development. Tropical nurseries kept him a child; whereas in the North Temperate Zone, Nature cradled and schooled him; forced him to work, to foresee, and to save; and by giving much and yet withholding much, allowed him to develop, and to gain his birthright. In the northern cyclonic regions man has become a dynamo with strength and desire to work, to build great cities, and to found far-reaching empires, and modern history is largely due to the initiative and prowess of the north-western mind, which dominates the world and seeks the keys to the mysteries of life.

Location. The location of a country is of supreme importance in its history, its trade relations, and its economic development. It outweighs every other single geographic factor. Russia's location made her the bulwark of progressive Central and Western Europe against the attacks of Asiatic hordes, and has hindered her progress far more than her small sea-board or her monotonous surface. The favourable position of Phoenicia enabled her people to dominate the Mediterranean area, and the commercial and maritime supremacy of Holland from the thirteenth to the middle of the seventeenth century was largely due to her exceptional position at the mouth of the great Rhine highway. Britain, on the north-western outskirts of Europe, of Europe yet not in Europe, has been greatly freed by her insular position from the paralysing effects of European wars and pestilences. Her peripheral location, before the Atlantic became the maritime field of history, caused her ports to be mere outposts on the bounds of a waste estranging sea; but she awoke to the possibilities of her new location as a focus of routes and trade with the widening of the world horizon, and is now the greatest commercial power.

Variation in Relief. Darwin shows that vastness of area, more than anything else, affords the best conditions for rapid and improved variation through natural selection. A large area stimulates differentiation by presenting a great diversity of natural conditions, each of which tends to produce its appropriate species or variety.

The vast and varied continent of Eurasia, extending from the Equator far beyond the Arctic Circle, shows a much greater progress in the evolution of animal and vegetable forms, race, and civilization than the small land mass of Australia with its more monotonous geographical conditions. Eurasian man learned, on the fierce battle-grounds of that continent, lessons which enabled him to conquer, without great difficulty, the more isolated groups of the Southern Hemisphere. The fact that he took with him the animals of the north, which have also thriven at the expense of the native forms, shows that the hold of the southern animals upon their habitat was no less precarious than that of man himself. Evolution demands a struggle for space and, eventually, the higher forms of life supplant the lower. Nations are on the downward path when they renounce their hold on their lands, or utilize their geographic resources in a primitive way, as witness the decline of the Red Indians and the Kaffirs. Britain's world-wide Empire, inhabited by progressive peoples, and blessed with varied conditions, possesses excellent possibilities for future advance in civilization. Man's future adaptation to his environment will demand from him constant vigilance, accurate knowledge, exact thinking, inspired imagination, and charity.

The Sea. Man found his adaptation to the sea vastly more difficult than to the land, but the harder struggle has given him greater intellectual and material rewards. Mobile man, by appropriating the mobile forces in the air and water, is now a cosmopolitan, and mankind may be said to reflect the unity of atmosphere and hydrosphere. The eternal restlessness of the moving waters aroused early man's curiosity as to their destiny, and navigation became in him an early instinct. Rivers carried him down to the sea in his frail boat, and the grey dawn of history found him an adventurer on the less stormy inland seas. Still later, in the last decades of the fifteenth century, with acquired higher nautical powers, the ocean lost for him its barrier nature, and new worlds were discovered. To-day, the world-ocean highways exhibit one of the highest phases of man's adaptation to his environment. The striking facts about the modern great world-ocean are the clustering of mankind round the shores of the seas and oceans, and the manifold relations established between the dwellers on the numerous coasts. Immediate contacts take the place of the former far-distant relations. Marine cables, telephones, wireless telegraphy, and steamer and sailing routes combine to promote the world relations of peoples, and over the wide waters the commercial, political, and intellectual activities of mankind move freely from continent to continent. Nations dwelling on the highways of the oceans, living in easy communication with distant countries, exchanging products and ideas, become the harbingers, carriers, and children of civilization.

The Coastline. The most important geographical boundary is that between the land and sea. Physically and economically considered, the coast is a zone of transition between the dominant forms of land and sea. Where the life-supporting land forces are weak as in Norway, the coast becomes merely the rim of the sea, compelling man to turn to the sea for his food, clothing, shelter, commerce and highway. Where the coast is dominated by exuberant life-supporting land forces as in the fertile river-basins of India and China, it becomes the hem of the land, and the ocean beyond a long-drawn barrier. Neither influence, however, wholly excludes the other, for the coast is the intermediary between the inhabited land and the international highway of the sea. Coasts have always played the rôles of barrier and threshold. To-day, we see them side by side. Yet, in spite of the great proportion assumed by transoceanic intercourse, it is evident that the greater part of the coasts of the earth are largely barriers and not outlets.

Interplay of Geographic Factors. It is necessary to study the interplay of geographic factors in human and national development. Britain's great economic development can be traced to a variety of land and water forces interacting. Long indented coast-line, limited island area, excellent mineral resources, prolific fishing-grounds in the surrounding shallow seas, large extent of comparatively poor soils, favourable climatic factors, and exceptionally favourable location for commerce, have all played their part in her great industrial development, her sea outlook, and resultant trade and colonization. Russia's slow development is due to excess of cold, deficiency of rain, outskirt location on the Asiatic border of Europe, which has exposed her to the attacks of nomadic tribes, a meagre and largely ice-bound coast, a monotonous surface, unfenced plains which dissipate the national energy, and difficulties of communication.

The geographical relations of man to his environment are subject to the law of development, and the physical environment favourable to one stage of development may be adverse to another and vice versa. Small isolated and protected habitats like Phoenicia, Greece, and Crete encouraged the birth and precocious growth of civilization, but later, progress was checked. Vast, cold, monotonous, wind-swept Russia lacks the small nurseries where Nature can aid her children, and so her boundless plains are still populated by a massive, uneducated, homogeneous people, who have received only the crumbs of culture from the progressive countries of Europe. When, however, Russia shall attain a higher stage of cultural and economic development, her vast area will become a great asset; many of her present geographic disadvantages will vanish; and she will enter into a long withheld inheritance. The evolution of geographical relations is well seen in the commercial history of Britain. When the Atlantic became the maritime field of history, Britain became a focus of trade, and not a merely terminal land. Her peripheral location had for centuries retarded her progress, but with the advent of Atlantic commerce her progress commenced. The modern opening of the Pacific presents a problem in geographical relations. Possibly, on its broad bosom, there will be decided in peace or in war the next great struggle of civilization.

Trade Routes. Trade routes on land exhibit strikingly the evolution of man's powers over physical obstacles. He has advanced from the primitive ridgeways to the complicated but excellent networks of roads and railways, found in all highly-civilized lands. Railways enable him to penetrate the interiors of continents, thus bringing "new" continents into commercial politics; help to unify peoples; convey food products as regular articles of commerce; develop tropical products by facilitating carriage where transport animals cannot live; limit natural disadvantages; and create new commercial powers. The United States is now a powerful commercial rival of Britain, and the opening of the tunnels through the Alpine folds makes Genoa the Mediterranean port for southern Germany.

The Struggles of Man. Civilized man is an active agent, moulding his environment for good or ill through the ages. He challenges Nature, and by observance of her laws modifies his physical environment. He multiplies his dependencies upon Nature, but diminishes the force of each factor; his bonds, though numerous, are far less rigid than those of the savage. Unlike the mendicant lower type, who accepts Nature's often meagre dole, he co-operates with her, and is less affected by her caprices. Civilized man's efforts in his warfare and fellowship with Nature are a wonderful study in evolution. Over climate he has shown little control, his powers being restricted to slight modifications of it by deforestation and afforestation, and by the draining of swamps; but physical obstacles to his trade and transport he has often overcome by navigation and engineering feats. He shortens routes by means of ship and barge canals; utilizes every natural aid, whether wind or current; lays his railways along the river valleys and plains, and through "water" and "wind" gaps and mountain and hill passes; and resorts to tunnelling or makes wide détours, when no other course is advantageous. The sea, in past times a nation-separator, is now a nation-unifier, and an essential link in associating all the branches of mankind. The progress from the frail slow boat of early man to the modern leviathan greyhounds and the advance from human and animal porterage to the inventions of railways and motors in the last century show an overcoming of the difficulty of mobility, and without such adaptation the modern industrial states could not have originated, and "new" continents could not have been opened out. Commerce has displayed great evolution as man has multiplied his relations with the earth. It has passed from simple tribal barter to the complex West European type, characterized by the exportation of manufactured goods, and the importation of food products and raw materials for the numerous peoples, with a speculative trade in addition. Modern industrialism, distinguished by combinations of various forms—trusts, cartels, and consolidations—is largely the result of man's mechanical inventions, and his development of transport facilities. Man can send his voice in a fraction of time around the earth; he has made wind, water, steam, and electric power his servants; and it is not unreasonable to assert that he will ultimately harness the tides and utilize the stored-up energy of elements. " Year by year, man increases his mastery over the physical forces ; he coins wealth out of the thin air ; he annihilates distance with his shrewd devices ; he makes the ether carry his message ; he is extending his rule to the heavens ; and he is making experiments on the control of life itself." On vegetable and animal life scientific man has large controlling powers. He acclimatizes and breeds types suited to varied climates and soils, and improves the yield and quality by hybridization and scientific selection. The problem of the pressure of population on the food supply he has partly solved by his improved transport facilities, his practice of intensive scientific agriculture, his " dry-farming " and irrigation projects in arid and semi-arid lands, his discovery of the secrets of various tropical diseases, and by his emigration to " new " countries. Research work in phenology, weather-forecasting, and the efforts now being made to discover the heat constants of the cereals give promise of better returns to the future operations of agriculturists. Man promises to exploit the tropics either by the hybridization of races, by the more difficult acclimatization of white races, or by the immigration of more vigorous tropical peoples. He hopes, eventually, to make a complete conquest of the air, and thus add to his mobility and his transport forces. By means of improved transport facilities and the aid of sanitation man is enabled to live in masses, and the " con-urbations " of his creation, whose limits he cannot yet fix, have led him to improve his surroundings by town-planning movements and the formation of garden cities, which help him to restore the healthy balance of nerve and muscle, and the legislation of civilized nations is ever seeking to uplift and better mankind.

MAN IN SOCIETY.—Geography accepts the truth that all the different races of mankind are but varieties of one single stock, but emphasizes the individuality of every community, and demonstrates that each human society is a growth of the region which it occupies. Regional consciousness is a function of mankind, and the diversity of communities reflects the diversity of the environments. It must, however, be understood clearly that though man develops as an individual, he realizes his fullest powers only in a constantly developing society, and that he returns to society with usury the gifts with which society has endowed him.

Personality does not live within itself to perish with the individual life, but goes forth into the everlasting life of man ; and so society, which has created man, is by man transformed. Man's co-operation with his fellow-men stimulates his mental development, elevates his personal nature, and uplifts his soul. In his very flesh and bones is the impulse towards larger and larger fellowships. He is striving to attain the perfect unit, the complete communion of all living members, the reconciliation of nationality with internationality. His League of Nations is a sign that he recognizes that the ideal basis of progress is the expansion of the world relations of a people, and the extension of its field of activity and sphere of influence far beyond the limits of its own territory. Highly-civilized societies at home are now multiplying their relations with their own land, while their highly-organized governments are enabling them to multiply their relations with the whole-producing world. At home the bond of Motherland closely knits the units of nations together, while, in the world at large, humanity is conceiving a brotherhood of man through the common growing bond of the earth, and evolving a social idea vaster far than that underlying nationality, and gradually creating a great world state, which will be populated finally by happy, peaceful, contented, and eventful people of many varying types.

Man is now in a phase of rapid and unprecedented development. The conditions under which he lives are changing with an ever-increasing rapidity, and such changing conditions must profoundly change him. It is easy to perceive growing knowledge, growing order, growing idealism, and deliberate improvement in the blood and character of man ; and imagination can picture the dawning of a day in the unending succession of days when he will approach the perfect type. Man will then have gained the fullest religious insight and experience which will link the human life with the Eternal Source of life, thus making for increased energy and social unity.

The world problem, now and in the future, lies in the filling up of the "new" and the sparsely filled lands by advanced types of society, in the world relations of peoples, in the greater economic and intellectual stimulus of nations, in man's closer fellowship with Nature, and in his fuller conception of the Creator and continued progress to the perfect type of life—the perfect communion of individuals and nations.

CHAPTER II

THE PHYSICAL BACKGROUND—RELIEF AND CLIMATE

"The Universe, broad, deep and high, is a handful of dust which God enchants."—*Theodore Parker.*

THE value of the earth to man depends upon the arrangement of the surface relief, for this determines the distribution of land and water; and hence, the physical map is the basis of the study of commercial geography. It is essential to picture the earth as the home of man, favouring his development in certain regions and retarding him in other, and to estimate his response to the differing environments. Man cannot be studied scientifically apart from the field of his activities, from the ground which he cultivates and mines, the lands over which he travels, or the seas over which he trades and exchanges ideas. Like all other forms of life he lies under the control of surroundings and climate. He is part of the earth's control, of the law of her evolution, drawing his life-blood from her, until his little span is complete. His ideals and creativeness are more truly part of the universe than his routine and mechanism.

(*a*) **RELIEF.**—The earth is almost a spheroid in shape, and is wholly covered by its gaseous mantle, the atmosphere. It is slightly flattened on four faces on which the oceanic waters have collected, and tends towards the shape that a sphere assumes, when attempts are made to press it into a tetrahedron. During its making it has passed through four main stages. First, the consolidation of metallic meteorites into the solid globe; second, the separation of the crust, the lithosphere, from its metallic core, the centrosphere or barysphere; third, the condensation on to its surface of the waters which now compose the oceans; and fourth, the buckling of the surface into the elevations known as the continents, and into the great basins, which contain the oceans. Chemical and physical forces prepared the surface for the lower forms of life, from which through the aeons the higher types have developed.

Distribution of Land and Water. It is noteworthy that because the earth is tetrahedral in shape four-fifths of the lands of the

Northern Hemisphere lie between latitudes 30° N. and 60° N., where the variable climatic conditions urge man to vigorous effort, whereas four-fifths of the area of the southern land masses lie in regions too warm and monotonous to promote human progress; that the Northern Hemisphere contains thirteen times the land area of the Southern Water hemisphere; that the lands and oceans are very often triangular in shape, the land triangles tapering to the south, the oceanic to the north; that the distribution of land and water is antipodal; that the lands of the world form a nearly complete ring around the Northern Hemisphere and project southward from this ring in three pairs of continents; that the oceans form a complete circle around the Southern Hemisphere and project northward, gradually tapering between the widening lands; and that at opposite poles there are the deep Arctic Sea and the high Antarctic Plateau.

Rocks—Primary and Secondary. The original rocks of the lithosphere were formed by direct solidification of molten material; they are called primary rocks. Such rocks are usually rich in valuable minerals, and are non-fossiliferous, unstratified, and crystalline. All rocks which have solidified from a molten state are also called igneous. Some, like granite, formed deep below the earth's surface and therefore under enormous pressure, are always crystalline and are classified as plutonic rocks; while others, like lava, formed by outpourings on the earth's surface and solidification in contact with the air, are often glassy and non-crystalline, and are known as volcanic rocks. When exposed on the surface of the earth the primary rocks have been broken up, and their constituents have been re-deposited by water, wind, or ice, and they are then known as secondary, sedimentary, and stratified rocks. They are fossiliferous, and belong to four chief groups—sandstones, clays, limestones and coals. Secondary rocks cover a large portion of the earth's surface, and form the foundations of the most densely peopled, most wealthy, and most powerful areas. Many rocks, which were originally sedimentary, volcanic, or plutonic, have sometimes been changed so profoundly by great pressure and high temperature that their original character has practically been destroyed; to these rocks, which are of widespread occurrence and often contain considerable quantities of metallic ores, the name, metamorphic, is applied. Slate, marble, gneiss, and schist are typical examples.

Geological Eras. The total thickness of the sedimentary deposits on the earth, tilted and exposed to view so that their order of superposition can be traced by man, is about 130,000 ft. The lower half of this huge basal mass contains no fossils, probably on account of the soft, shell-less, and boneless nature of the life existing when the rocks were in process of formation. The 65,000 ft. of deposit above it contain fossils showing, as the rock series are ascended, higher degrees of evolution in animal and plant life. Fossils, therefore, reveal the history of life on the earth, and the geologist speaks of four great eras. The first era, subdivided into the periods, *Archaean* and *Torridonian*, is supposed to include the dawn of life (though no fossils of that era have yet been found), and is called the *Eozoic* or *Archaeozoic*. The second era, known as the *Primary* or *Palaeozoic*, subdivided into the *Cambrian*, *Ordovician*, *Silurian*, *Devonian*, *Carboniferous*, and *Permian* periods, shows in its rocks fossils of old forms of animal and plant life, the earliest known remains of living things, the strange shrimp-like Trilobites and the Lingulas being found in the Cambrian rocks. The third era, known as the *Secondary* or *Mesozoic*, and subdivided into the *Triassic*, *Jurassic* and *Cretaceous* periods, is often called the Age of Reptiles, because large reptiles then abounded. The fourth era is the present, the *Tertiary* or *Cainozoic*, subdivided into the periods, *Eocene*, *Oligocene*, *Miocene*, *Pliocene*, *Pleistocene*, and *Recent*. It is the era of mammals, man evolving probably in the late Pleistocene period. No exact estimate can be made of the time represented by the various strata, but geologists assign half a million years to the formation of the 250 ft. of Pleistocene strata.

Highland, Upland, and Lowland. Geographers have agreed to call all land between sea-level and 600 ft. altitude, Lowland; between 600 ft. and 2,000 ft., Upland; above 2,000 ft., Highland. Lowland plains include the greater part of the dry land area of the earth, and wherever they are favoured with advantageous climates, fertile soils, and easy access to the sea, they become the most densely populated regions of the world. Highland plains or plateaux are among the most thinly populated regions.

Earth-blocks, Fold Mountains, and Sedimentary Rocks. The lands of the world are built on three main types of structure—massive raised blocks, crumpled bands, and widespread sheets of sediments. Of these, the oldest are the massive earth-blocks, which consist wholly or have a very wide foundation of very old rocks, and have stood above sea level throughout all geological time. They have been termed the earth's "Coigns," and include Scandinavia, Labrador, the Deccan of India, most of western Australia, the highlands of eastern Brazil, and much of tropical Africa. More widely distributed are the crumpled bands, which are now in two conditions, dependent mainly on age. The younger lofty fold mountains are in long continuous bands, and are well seen in the Alpine-Himalayan mountain system, which traverses Eurasia along a sinuous line from east to west, and the Circum-Pacific mountains, consisting of the western mountains of North America, the Andes of South America, and the mountain fragments forming a chain of islands from Japan to New Zealand. The older and less lofty fold mountains have been broken up and weathered, and are found as scattered highlands, typical examples being the plateau of Bohemia, the Harz mountains, and the Appalachians. Between the "Coigns" and the folded belts are the broad plains of comparatively young sedimentary rocks, types of which are the central plain of North America and the great European plain.

Life on Mountain and Plain. Mountains and plateaux influence the life of their inhabitants fundamentally and variously, but ever reveal their barrier nature, limiting agriculture and restricting trade and travel. Highland countries almost invariably compel emigration of their children. Population is repelled by their inaccessibility, and their harsh climatic conditions. Such regions force man to unending labour, give little leisure, and much anxiety for the morrow. Isolation and confinement discourage the budding of genius and retard man's development. To the human mind, however, towering mountains convey a sense of loftiness and greatness; and highlanders, indifferent to luxury and endowed with strong muscles, iron purpose, and perfect nerves, become formidable competitors, and often the conquerors of the peoples of the lowlands.

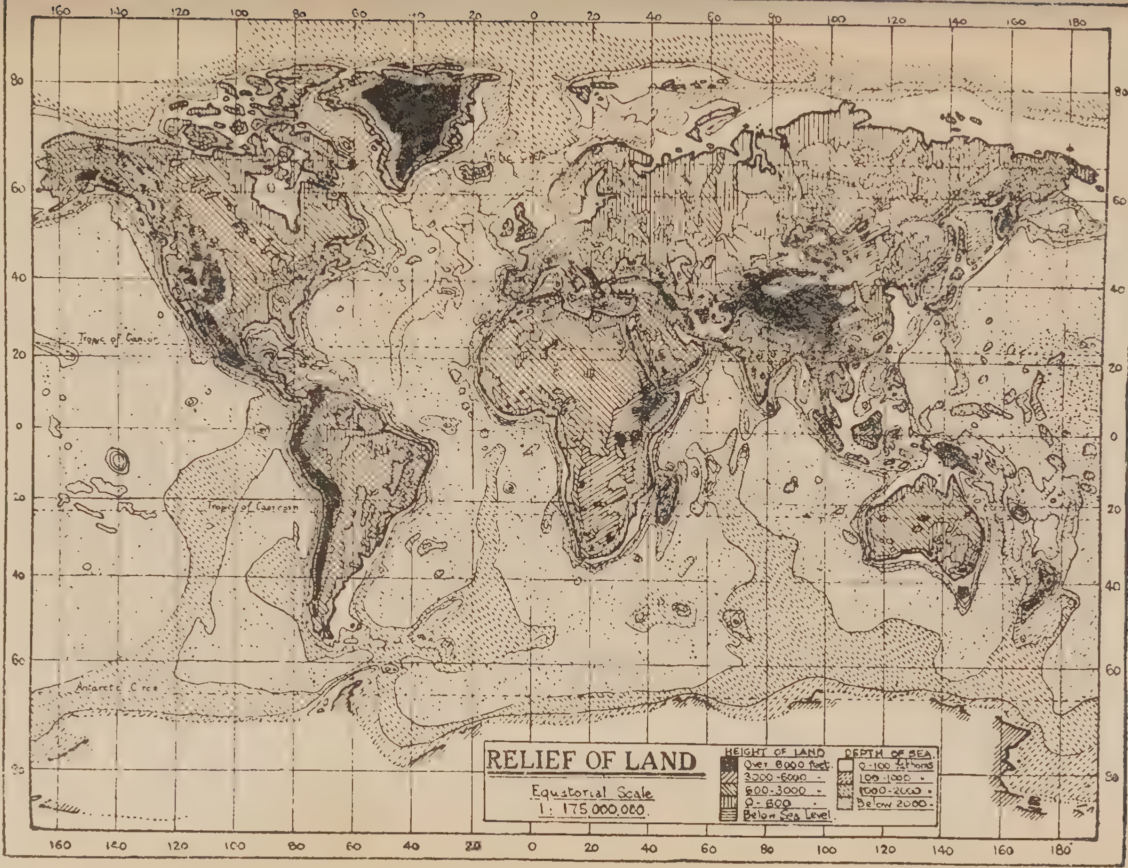
The well-watered plains encourage ethnic, commercial, and political expansion. They favour agriculture, trade, and intercourse. In them the whole range of historical movements meets no obstacles save the waters gathering in their runnels and the forests which flourish in their rich soils. The simple structure collects the people, and starts them moving in broad streams. Power to master extensive lowlands comes late in a nation's history, but once attained, political expansion becomes a dominant characteristic of the dwellers on the plains. On arid plains quiescence is excluded, the wander habit is eternal, migration permanent. Wealth is difficult to accumulate, and progress almost stands still. Lowlands often lack the distinctive advantages of highlands shown in their diversity of climate, water power, more abundant forests and mineral wealth ; but the easy conditions of life usually found on the plains give them their predominant segregating influence.

Europe. The origins of most of the Europe of to-day lie well within the Tertiary Era, but the greatest variety in relief is found. The north-western lands, including Finland, Scandinavia, most of Scotland, and part of north-western Ireland, consist of old earth-blocks which rarely contain much mineral wealth, are unfavourable to agriculture, force their inhabitants to turn to the sea for highway and opportunity, and compel the export of men. More than half of the continent is a diversified plain of sedimentary rocks under 700 ft. high, which stretches from the Pyrenees and the western mountains of the British Isles to the Russian Urals, and is only interrupted by the secondary " coigns " of the Ardennes and the hills of Brittany. Lying open to the Atlantic winds and allowing easy communication (the country from Cologne to the Urals can be crossed without going through a single tunnel), this lowland encourages agriculture and has become the home of energetic races. Other plains are the fertile basins of Hungary, Lombardy, and Wallachia. Sweeping complex fold-mountains of the Alpine system—the Sierra Nevada, the Pyrenees, the Alps, the Apennines, the Tatra, the Carpathians, and the Balkans—are characteristic of southern Europe. Their irregular course is due to the resistance of the old earth-blocks known as the Meseta or main plateau of Spain, the central plateau of France, the Black Forest in Germany, the plateau of Bohemia, and the Russian platform in south-western

Russia. These mountains and plateaux have formed barriers to communication between the inhabitants of northern and southern Europe, and have aided in the formation of two distinct types of civilization—the progressive, energetic, oceanic type of the north-west and the earlier, less energetic, artistic, inland-sea type of the Mediterranean lands.

The longest European rivers are those which cross the plains of south-eastern Russia, Hungary, and Jugo-Slavia—the Volga 2,200, and the Danube 1,700 miles long. The latter is an international highway, and the former, although ice-bound during the severe Russian winter, is of much commercial importance to Russia. The Alpine rivers—Rhone, Rhine, and Po—have slow, steady courses, and form waterways of great value, sometimes enhanced artificially by the deepening of their beds and their inter-connection by canals.

Asia. Asia is now widely linked with Europe, but in an early age it was separated from it by a sea which connected the Arctic and Indian Oceans. Four great physical divisions of the continent may be distinguished—the north-western Lowlands, the Central Highlands and Plateaux, the Southern Plateaux, and the Eastern Margins and Island Ranges. Beyond the Urals stretch the great plains of Siberia, formed of sedimentary rocks—some young, some very old—and drained by the three great rivers, the Ob-Irtish, the Yenisei, and the Lena, which flow to the almost useless Arctic Ocean. The south-western portion of the northern Lowlands is an area of inland drainage, where the Aral sea receives the waters of the Syr-Daria and the Amu-Daria. The whole area is thinly populated, and awaits development by races capable of utilising its resources by improvements in transport and the adaptation of farming methods to the existing climatic conditions. The Central mountain system is the longest, broadest, highest, and most complicated in the world. Generally speaking, the mountain chains run in an east and west direction, and between them are lofty plateaux, which are wider in the east than in the west. Two structural groups may be differentiated, a series of parallel fold ranges enclosing plateaux and deep valleys, and a much older folded eastern mass, which has been very much worn down. In the first group, three chains come very close together in the Pamir plateau. They are the Caucasus and Thian Shan; the central



THE RELIEF OF LAND

chain consisting of the Pontic, Elburz, Hindu-Kush, and Kwen Lun mountains; and the Taurus, Zagros, Sulaiman, and Himalaya mountains. Between the first and second chains lie the great basins of the Black Sea, the Caspian Sea, and the Tarim basin; whilst between the central and third chains are the plateaux of Asia Minor, Iran, and Tibet. The Himalaya mountains consist of a number of parallel ridges, one of which includes a series of lofty peaks, among them Mount Everest, over 29,000 ft. high. To the east of the lofty plateau of Tibet the folded ranges turn southwards owing to the resistance of the old Chinese plateau, and a series of north and south chains traverses Indo-China. The older Eastern Highlands consist of uplifted blocks, which form the Altai, Sayan, Yablonoi, Stanovoi, and Khingan mountains. From many of the mountains of this central system flow great glaciers, which give rise to the long rivers of the south and east—the Euphrates and Tigris from the Armenian plateau; the Indus, Ganges, and Brahmaputra from the Himalayas; and the Salwen, Mekong, Yang-tse-Kiang, and Hoang-Ho from the plateau of Tibet. Asia's mountain backbone has given birth to wild, nomadic conquerors, has isolated China, and has largely caused the deserts of central Asia. The fertile river valleys encouraged the early civilizations of China, India, and Mesopotamia (Irak), and still support a dense agricultural population. The two plateaux of Arabia and the Deccan, which at one time formed part of an ancient continent stretching thousands of miles in an east and west direction, rise in a few places to over 6,000 ft. They are separated from the plateau region of Africa by the rift valley of the Red Sea, and from the remainder of Asia by the Indo-Gangetic plain and low-lying Irak. The eastern volcanic mountains border the eastern shores, and stretch through the peninsula of Kamchatka, the Kurile Islands, the Japanese Islands, the Lu-Chu Islands, the Philippines, the Moluccas, and the Sunda Islands. They form part of "the Fiery Ring of the Pacific," and contain Fuji-San, the sacred mountain of Japan, and Krakatoa, the destructive East Indian volcano. Naturally, the peoples living on the unstable edge of eastern Asia have become stoics and fatalists.

Africa. Most of Africa consists of a vast plateau, once continuous with the tablelands of the Deccan, Arabia, and Australia, and composed of rocks of great antiquity. It extends from the Sahara on the north to the Cape of Good Hope province on the south, and from Somaliland on the east to the Guinea coast on the west. A line drawn from Loanda, south of the Congo, to Suakin on the Red Sea, divides the plateau into two distinct areas—a low tableland on the north and west of 1,500 to 2,000 ft. average height, and a higher tableland on the south and east of 3,000 to 4,000 ft. average height. In East Africa great crustal blocks have been let down between parallel faults, forming great rift valleys. One of these passes from the Red Sea south of the Abyssinian tableland and then turns southward to the east of Lake Victoria. Lakes Rudolf and Nyasa lie in this valley. Another rift valley forms the beds of Lakes Albert, Edward, and Tanganyika. The highest ridge of the plateau runs almost due north and south, following a line of volcanoes, containing both active and extinct types, the chief peaks of which are Kilima Njaro (19,000 ft.) and Kenia (17,000 ft.). No other equal area in Africa has such a great average height as Abyssinia, where so much lava has been poured out that lofty highlands have been built up. The young folded mountain chains of the Atlas in the north-west are intimately connected with Europe in structure. Lack of a definite water-parting explains why African rivers flow in every direction ; the Nile (4,000 miles) flowing north to the Mediterranean Sea, the Congo (3,500 miles) flowing to the west, and the Zambesi (2,000 miles) flowing to the east. The African plateau is the home of the giraffe and the two-horned rhinoceros, the land of the negro, and one of the world's greatest undeveloped assets. Commercial development of the continent has been hindered greatly by the plateau structure, for though the rivers may be navigated for great distances upon the surface of the plateau, their lower courses consist of rapids and waterfalls down the steep slopes near the coast. High plateaux near the coast shut out the climatic influence of the sea, and prove great obstacles to railway construction.

North America. North America consists of two ancient mountain masses, one in the east and the other in the west, and between them a vast plain extending northward from the Gulf of Mexico to the Arctic Ocean. The Western Highlands, or the Cordilleran area, are a highly-complicated group of mountain chains, interspersed with wide tablelands. They are widest in the latitude of San Francisco and Denver, where they are about 1,000 miles across. Long, high ranges border the plateaux both on the east and west, the Rockies on the east, the Cascade and Sierra Nevada mountains on the west. The Great Basin, an inland drainage area containing the Great Salt Lake; lies between the Rockies and the Sierra Nevada, and attains a greater average height than any other portion of the Western Highlands. The valley of the St. Lawrence divides the Eastern Highlands into two main divisions—the Laurentian Shield in the north and the Appalachian system in the south. The Laurentian Shield consists of low or swelling ground, which reaches the elevation of a mile only in the east of Labrador. It is an ancient fold-land, covered with very thin soil, and often large areas of bare rock are exposed. Its edge is marked by a long chain of lakes, from Great Bear Lake on the Arctic Circle to the five great lakes—Superior, Huron, Michigan, Erie and Ontario. The Appalachian Highlands, which extend from Newfoundland almost to the Gulf of Mexico, parallel to the Atlantic shores, consist of a series of ridges and valleys, and have not half the length, breadth, or height of the western Cordilleran region. Between the Appalachians and the Atlantic coast lies the Atlantic Coastal Plain, narrowing in the north-east but widening southward to 200 miles. The Central Lowlands are a series of plains and low plateaux covering an area about twenty times that of the British Isles. They slowly sink from an elevation of 5,000 or 6,000 ft. at the base of the Cordilleras to the trough of the Mackenzie, Mississippi, and the Great Lakes, and gradually rise to the Eastern Highlands. The eastern and western mountain masses of North America are great barriers to communication, but they contain much mineral wealth which is now being exploited. It is noteworthy that in the Old World the direction of elevation is eastward and westward, while in the New World it is northward and southward, permitting icy Arctic winds to penetrate far south into the central lowlands, a great world granary. The chief rivers of North America carry the main drainage of the great plains to the Arctic Ocean or the Gulf of Mexico. The Mississippi-Missouri (4,220 miles) system provides about 16,000 miles of navigable waterways for the greater part of the year, the Mississippi affording continuous navigation up to the falls of St. Anthony and the Missouri to Great Falls at the foot of the Rockies. By the St. Lawrence and its canals, sea-going vessels drawing slightly less than 14 ft. reach Duluth at the head of navigation on Lake Superior, 2,000 miles from the Atlantic, and the largest ocean liners can reach Montreal, a thousand miles up the waterway. The Hudson-Mohawk system is of very great commercial importance, as it provides the only deep-water passage through the Appalachians, and comparatively easy gradients for the railways.

South America. Like North America, the continent of South America consists of three distinct natural areas—the Western Cordilleran area, the Central Plain, and the Eastern Highlands. The vast folded mountain system of the Andes or South American Cordillera is the least broken of all mountain systems. It extends the whole length of the continent from Panama to Staten Island, a distance of 4,500 miles, and varies in width from 5 to 500 miles. From Cape Horn the Andes run for about 2,000 miles in a comparatively simple, single line, up to the great westward curve of the coast ; from this point they become a double chain, enclosing the Bolivian plateau ; and northward they become a treble chain. The Eastern Highlands are subdivided into the Guiana Highlands in the north, and the Brazilian Highlands in the east. They are fragments of an old continent, and are composed essentially of flat-lying rocks, which have been greatly worn down by atmospheric agencies. The Central Plain lying between the Eastern and Western Highlands stretches from the north to the south of the continent, and is the uplifted bed of an American " Mediterranean " Sea. The Amazon (the world's largest river, and in reality " a gigantic island-filled reservoir "), the Orinoco, and the Parana-Paraguay drain the fertile lowlands, and are connected at their sources, the Orinoco with the Amazon, and the Amazon with the Parana. At certain seasons of the year the lowland country becomes inundated to such an extent that it presents, in miniature, a picture of the primeval inland sea. Fortunately, the rivers are navigable for great distances inland. Ocean vessels reach Iquitos on the Amazon, 2,300 miles from the ocean, and the Orinoco is navigable for 1,000 miles. It is worthy of note that the Eastern Highlands are rich in gold and diamonds, while the Andes have for centuries yielded gold, silver, copper, and tin.

Australia. The long isolated continent of Australia has a remarkable structural resemblance to South America, but the arrangement of two of the regions is reversed. The Eastern Cordillera, or highlands, are not folded ranges, but consist of an ancient highland mass, which was worn down and then uplifted. They stretch from Cape York to the Murray mouth, a distance of 2,000 miles, and rise abruptly from the sea. The highest portions of the mass are in the south-east, where mountain peaks are closely grouped; northward, the system is connected with the Asiatic by the mountains of New Guinea and the islands of the East Indian Archipelago; and southward, Tasmania forms a portion. The Great Divide, unfortunately, makes east-west railway construction most difficult, and prevents sea winds from penetrating the interior. On the west of Australia an ancient "coign" extends from the west coast eastwards for 1,400 miles, its eastern boundary following a sinuous line from Spencer Gulf to the Gulf of Carpentaria. The surface of the tableland is generally level, and has an average elevation of over 1,000 ft. Between this western plateau and the Eastern Highlands stretch the Central Lowlands, the uplifted bed of a primeval sea. Australia has few important rivers, although a physical map shows a fairly imposing array on the east. Many streams are, during most of the year, a series of detached pools connected by dry-water channels, and frequently they have bars at their mouths. Rivers, which have no perennial or permanent sources, are called "creeks"; they often flow into lakes or lose themselves in the sands and wastes. Among these "creeks" are the Eyre, Diamantina, and Cooper, draining at certain seasons to Lake Eyre, the surface of which is 40 ft. below sea-level. The Murray-Darling system is the only natural means of inland navigation, and this waterway suffers from serious disadvantages. The Murray is navigable for about eight months of the year from the foot of the Eastern Highlands to the sea, a distance of about 1,400 miles, but a bar effectually prevents steamers from leaving the river; the Darling is navigable for 1,200 miles, and the Murrumbidgee for 600 miles. Improvements in the navigation of the Murray and Murrumbidgee are now being made by constructing locks and reservoirs on the lower courses of the Murray, which will tend to keep up the water level during the dry season.

The Continental Shelf. The lithosphere may have been covered once by an unbroken sheet of water, but now the hydrosphere occupies only five-sevenths of the surface. Round all the continents the land slopes gently, forming a continental shelf covered by seas under 600 ft. deep. The contour, or isobath, of 100 fathoms, roughly outlines the true borders of the continents, and beyond it there is a rapid slope leading down to the fairly uniform ocean plateau, which is broken here and there by the great ocean abysses, the greatest depth reached being about six miles. Over the shelf is spread the waste of the land, the coarse lying near the shore-line, the finer extending outwards to the steep seaward slope. In some places the continental shelf is slowly being uncovered; in others, the land is sinking and the shelf is thus being broadened. Where the continents are bordered by a mountain margin, the shelf is narrow, but it widens where extensive lowlands face the ocean. Its importance lies in its rich fishing grounds and its effects on commerce.

Oceans. The oceans are those great divisions of the hydrosphere which are cut off from each other, more or less, by the continents. South of lat. 40° S. lies the Southern Ocean, which in lat. 60° S. completely encircles the globe; the term, Antarctic, is applied to its southern edge. Northward, stretch the three great oceans—Atlantic, Pacific, and Indian. The S-shaped Atlantic, the sea-canal between the Old and New Worlds, lies open to the Norway and Arctic seas. It was the first ocean to be crossed; it has the busiest trade routes; and it receives no less than half the river drainage of the world. Larger and broader, the mis-named Pacific, an immense oval basin, is almost land-locked to the north, and promises with the awakening of the Far East greater commercial activity on its broad bosom. The Indian Ocean, the feeder of monsoons, is closed in by the continent of Asia, and though now a highway of great and increasing trade, it carried practically no commerce till the sixteenth century.

History has always produced its most dramatic acts upon the margins of seas and oceans. Rome, of the seven hills, is dwarfed by Britain of the "Seven Seas." The resources of the vast waters first tempted man to trust himself to their dangerous surface; and he fell heir to a wealth of experiences and influences when he converted the untrodden water wastes into a highway for his merchandise. Every great epoch of history is associated with its own sea, and every succeeding historic advance has enlarged the maritime field. The Greeks acquired the Aegean, the Romans the whole Mediterranean, and in the Middle Ages the Nordic race gained mastery of the North and Baltic seas. Modern history is bound up with the Atlantic ; and the twentieth century witnesses the efforts of progressive European races to utilize to its fullest extent the great world ocean. One great function, which the ocean has always performed, is the provision of an outlet for the exercise of redundant national powers. Without its vast barriers the different branches of the human race would have resembled one another much more closely, but with a resulting loss of development. Navigable oceanic waters are of supreme importance to-day to civilization and commerce. They associate all the branches of mankind, and enable the distant parts of the earth to contribute to the support of other parts. They are one of the chief factors in the growth of the world's largest cities. They regulate the rainfall and temperature of the lands ; and are an important link in helping to accomplish the perfect understanding between nation and nation.

(*b*) **CLIMATE.**—Climate, the variable factor in geographical environment and the major factor in determining the permanent settlement of the regions of the earth, may be defined as generalized weather. It is concerned with a large area and a long period of time, and embraces the mean values of the elements—temperature, pressure, wind-direction and velocity, sunshine, cloudiness, humidity, and precipitation. All of these factors are closely interwoven, and it is impossible to isolate wholly the study of any one from that of the rest.

Temperature. The temperature of the air at the earth's surface depends on the latitude, the height of the land, and the distribution of land and water. Insolation, or radiant energy from the sun, comes to the earth in waves of varying lengths from the farthest depths of space through the all-pervading ether. A small fraction of the sunshine is reflected by the thin upper layers of the atmosphere, but the greater number of rays enter, and are transmitted mainly to the earth, the air absorbing only a low percentage of the passing rays. The angle at which the sun's rays strike any given region of the earth largely determines the heating effect. Each unit of area exposed to a vertical sun receives a larger proportion of rays than one exposed to a slanting sun, and less heat is arrested when passing vertically through the air than when passing obliquely. Consider Fig. 1. Let $NESE'$ represent the earth; $PQRT$ the upper limit of the lower and denser atmosphere; $ABCD$ the upper limit of the atmosphere; and G, H, and K bundles of rays of equal size falling on the globe. Bundle H falls directly on the equatorial belt; K more obliquely on the temperate region; and G falls on the north polar region more obliquely still. The diagram shows clearly that the same quantity of heat is spread over larger and larger areas the more the rays slant, and so the heating effect per unit is less and less—area $d\ E\ e$ is less than $d'\ V\ e'$, while $d'\ V\ e'$ is less in area than $d^2\ X\ e^2$. It is also clear that bundle G passes through a greater thickness of atmosphere than bundle H, and hence loses more heat to the atmosphere than bundle H, especially when passing through the clouds, dust, and denser medium of the lower atmosphere. Latitude, or angular distance north and south of the Equator, enables calculations to be made of the angles of incidence of the sun's rays. On 21st March and 23rd September the sun's rays fall vertically on the Equator; on 21st June on the Tropic of Cancer (23½° N. lat.); and on 22nd December on the Tropic of Capricorn (23½° S. lat.). For London (51½° N. lat), therefore, the angle of incidence is 38½° (90° – 51½°) in March and September;

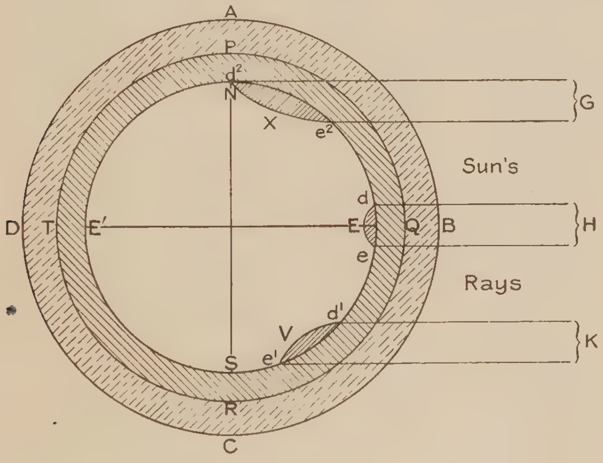
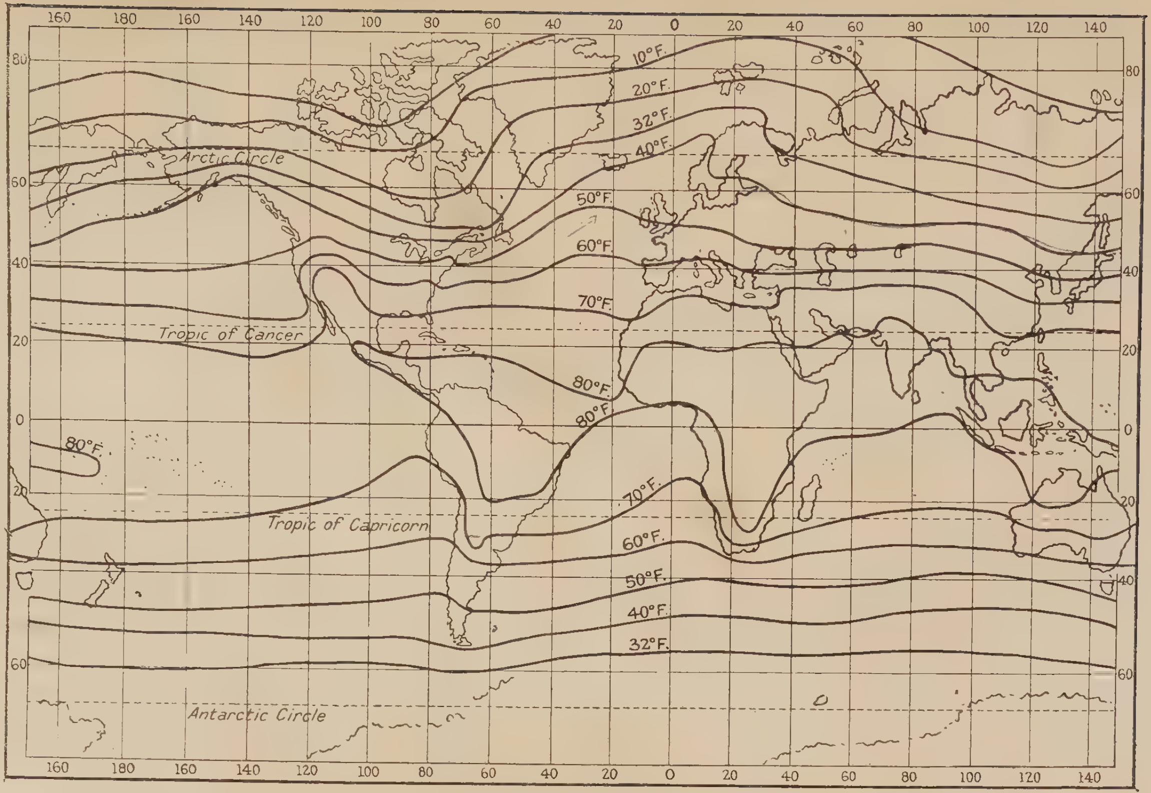


Fig. 1.—Insolation

$62^\circ (90^\circ + 23\frac{1}{2}^\circ - 51\frac{1}{2}^\circ)$ in June; and $15^\circ (90^\circ - 23\frac{1}{2} - 51\frac{1}{2}^\circ)$ in December. On 22nd December, a given surface in London receives 25·9 per cent, and, on 21st June, 88·3 per cent of the heat it would receive if the sun were vertically overhead. Temperature is dependent also on the length of the day, which also depends on latitude. Between the tropics the days are very even in length, never varying much above or below twelve hours; in British latitudes the days vary in length from six hours in mid-winter to eighteen hours in mid-summer; and at the north and south Poles a six months' day alternates with a six months' night. The great length of the summer days in high latitudes compensates for the great obliquity and weakness of the insolation, and enables annual vegetation to rush through its life cycle. Neglecting all other considerations but latitude, it is approximately true that the temperature of the air diminishes from the Equator to the Poles.

Radiation. The atmosphere is warmed both by the absorption of the sun's rays, which it directly intercepts, and by contact with, and radiations from, the earth. Heat rays that leave the earth are not luminous, but belong to the kind of radiation called dark heat waves. Fortunately, the atmosphere is more or less opaque to these long, dark ether waves, its transmitting power being dependent on its density and the amount of water-vapour and dust present. At high altitudes air is not so dense as at sea-level, and is freer from organic and inorganic particles; but though more insolation reaches a given surface at a high altitude than a similar one at sea-level there is less heat transmitted from the earth and much freer radiation into space. Thus, the air at the higher altitude remains the colder of the two. As far as temperature is concerned, the atmosphere is divided into two distinct regions—the lower region, the stratosphere, in which there is a fairly rapid decrease of temperature with height (the average value of the vertical temperature gradient for all seasons of the year, and for all places, is ordinarily considered to be 1° F. for each 300 ft. ascent); and an upper region, the troposphere, where this condition does not prevail. The boundary between the two divisions varies with the seasons, and with the geographical location of a place; in Britain, the average is about seven miles above sea-level. There is much food for reflection when it is realized that a thin zone of air above freezing



MEAN ANNUAL ISOTHEMS

point, approximately three miles deep at the Equator, which thins out northward and southward until it reaches ground level at the Polar Caps, enwraps the earth, tempers the heat of the day and the cold of the night, and renders all life possible.

Effect of Sea on Temperature. Water requires more heat than any other substance to raise its temperature through a given range; and in cooling from one temperature to another it gives out more heat than any other substance. If equal volumes of land and water with equal surfaces are exposed to exactly the same insolation, the temperature of the land is raised 1·7° C., while that of the water is raised 1° C. Water heats more slowly but to a greater depth, and retains its heat longer than the land. In summer, in the same latitudes, the land and the air over it are hotter than the sea and the air over it; in winter, the reverse conditions hold. Places near the sea have, therefore, cooler summers and warmer winters than places in the same latitude remote from the sea. Lands near the sea which have a prevailing wind from the sea share its cooler summers and warmer winters. Their climate, characterized by a small annual range of temperature, is termed *insular* or *maritime*, e.g.—

	Mean January Temperature.	Mean July Temperature.	Annual Range.
Waterford . . .	41·8° F.	60·0° F.	18·2° F.
Scilly Isles . . .	45·7° F.	61·2° F.	15·5° F.

Small islands far out at sea, possessing a very small annual range of temperature, are said to have an *oceanic* climate, e.g.—

	Mean January Temperature.	Mean July Temperature.	Annual Range.
Honolulu . . .	70° F.	77·5° F.	7·5° F.

Countries situate in the interiors of continents, to which the winds come from the land on all sides, have a *continental* or *steppe* climate with great extremes of heat and cold, e.g.—

	Mean January Temperature.	Mean July Temperature.	Annual Range.
Baghdad	50·9° F.	92·8° F.	41·9° F.
Kiakhta (Mongolia) . .	– 15·9° F.	66·4° F.	82·3° F.

The temperature of the world is mapped by drawing *isotherms*, or lines of equal temperature, through places with the same mean temperature, monthly, seasonal, or yearly. They are usually drawn as they would be if all the land were at sea-level. If the temperature of a place is shown on the isothermal map as 66° F., but its altitude is 1,800 ft., the actual temperature would be approximately 60° F. $(66° \text{ F.} - \frac{1{,}800°}{300} \text{F.} = 60° \text{ F.})$

EFFECT OF WINDS ON TEMPERATURE. The range of temperature is influenced directly by the prevailing winds. Over the Sahara desert the winds blow for the greater part of the year from the higher latitudes of Europe, lowering the temperature considerably; while the west and south-west oceanic winds are powerful agents in causing a mild climate on the west coasts of the British Isles. Heat is always liberated when rain is formed. Since heat must be absorbed in the conversion of water into aqueous vapour, there must be a liberation of heat when water-vapour is condensed. *Latent* heat is set free when rain falls, and it is noteworthy that the most rainy districts of the British Isles are, in general, the warmest in winter.

EFFECT OF SOILS ON TEMPERATURE. Soils play a part in the determination of temperature. They absorb and radiate heat in varying degrees. Black soils are good absorbers of heat, and to this fact the successful growth of spring wheats on the Canadian prairies and Russian steppes must partly be assigned. Land sloping towards the mid-day sun receives more heat than land sloping towards the rising or setting sun; hence the southerly aspect of many British orchards and the northerly aspect of many South African vineyards. Ocean currents, in conjunction with winds, may raise or lower the temperature of coasts. Thus, the winter climate of western Europe is made milder by winds blowing over the warm north Atlantic drift, while the temperature of western Japan is lowered by winds coming over the cold Kurile current. Cultivation often modifies the climate of a region. The clearing of forest land up to a certain point is productive of an increase of temperature and a beneficial diminution of the moisture; but, carried too far, as in the Mediterranean lands, it leads to increased evaporation and serious diminution of a country's productivity.

The extensive draining of marshy districts has resulted in an increase of their mean annual temperatures; and it is asserted that the extensive drainage effected in Great Britain since the commencement of the Industrial Revolution has increased its mean annual temperature by one or two degrees. Mountain and plateau barriers influence the temperature of a region by checking winds, both harmful and beneficial. The Himalayas cut off Tibet from the ameliorating action of the south-west monsoon, and the Carpathians protect the Hungarian plain from bitter north-east winter winds. The absence of a barrier along northern Canada allows the cold Arctic winds to penetrate the central plain, sometimes seriously affecting vegetation and agricultural operations.

Pressure. Winds are simply streams of air, which are named according to the direction from which they blow. Just as liquids seek their own level, moving from points of higher to those of lower pressure until equality of pressure is attained, so the air moves from the regions where the pressure is high towards those regions where the pressure is low, seeking to attain a level surface. Permanent differences of pressure cause *permanent* winds; while pressure differences at definite intervals give rise to *periodic* winds; and pressure disturbances resulting from local peculiarities of situation or from any other cause result in *variable* winds. Variations in atmospheric pressure are the results of alterations in temperature and of the increase or decrease of the amount of water-vapour held by the air. An increase of temperature produces a diminution in the density of the atmosphere, a consequent diminution of pressure and a fall of the barometer. Water-vapour is lighter than air in the proportion of 9 to 14·5; therefore, the greater the amount of water-vapour present in the atmosphere the less is the pressure and the lower the barometric reading. In order to map the pressure of the atmosphere in different parts of the world, it is customary to draw lines through all those places which, after making allowance for temperature and altitude, have the same barometric reading at a given time. Such equal atmospheric pressure lines are called *isobars*.

The Distribution of Pressure. The surface pressure of the atmosphere is least just north of the Equator (the Doldrums); approximately along the Antarctic Circle (66½° S. lat.); and along an ill-defined and varying line between 50° and 60° N. lat. The surface pressure is greatest approximately along latitudes 35° N. and 30° S.—the Horse latitudes or the calms of Cancer and Capricorn, respectively. Temperature and the distribution of water-vapour do not alone explain the localization of atmospheric high-pressure and low-pressure belts. Consideration must be given to the mechanical forces set up by the earth's rotation. The earth and with it the atmosphere rotate in the Northern Hemisphere around the North Pole, and the air tends to whirl away from the Pole and to heap up towards the Equator. Similarly there is a tendency in the Southern Hemisphere for the air to be whirled away from the South Pole and to be heaped up towards the Equator. High above the hot equatorial low-pressure belt, however, there is a tendency for the air to move polewards. The result of the conflicting tendencies—equatorwards and polewards—is the piling up of air at the Horse latitudes, thus creating high-pressure belts. Between latitudes 50° and 65° approximately, the whirling of the air away from the Polar regions leaves less air above this part of the earth, and so low-pressure areas result. It is manifest that in the Northern Hemisphere winds will blow from the northern belt of high pressure towards the Equator and from the same belt towards the Pole; while in the Southern Hemisphere there will be winds towards the Equator from the Calms of Capricorn, and from the same region towards the Antarctic Circle. The direction of these winds is modified by the earth's rotation, the effect of which is summarized in Ferrel's law: "If a body moves in any direction on the earth's surface, there is a deflecting force arising from the earth's rotation which tends to deflect it to the right in the Northern Hemisphere, but to the left in the Southern Hemisphere." In the Northern Hemisphere the northerly wind that would naturally blow in towards the equatorial low-pressure belt is deflected to the right of its path and becomes a north-east wind; while in the Southern Hemisphere the corresponding wind becomes south-east. These winds are *permanent*, and on account of the constancy of their direction are known as the north-east and south-east trade winds. The latitudinal limits of the trade winds are not fixed throughout the year, but vary with the seasons. In the Atlantic the north-east trades are felt between 7° N. and 25° N. lat.; while in the

Pacific they extend between 6° N. and 25° N. lat. The south-east trades blow between 2° N. and 21° S. lat. in the Pacific, and between 3° N. and 25° S. in the Atlantic Ocean. The poleward winds from the high pressure belt being deflected become respectively south-westerly and north-westerly winds. They are sometimes called anti-trades (though the name is more strictly applicable to those upper currents of air which blow over the trade winds and complete the great convection currents constituting the winds), and are also known as the stormy westerlies in the Northern Hemisphere, and as the brave west winds, or roaring forties, in the Southern Hemisphere. The two sets of surface winds, the trades and the westerlies, constitute the *planetary winds.* Zones in which there is little horizontal circulation of the air occur in certain latitudes. One of the most marked is the equatorial low-pressure belt. Its existence is due to the high temperature of the earth's surface along this belt, which causes the overlying air to expand and rise, its place being taken by the inflowing trades. Along this belt, therefore, air flows generally vertically upwards. The resulting belt of calm, characterized by great rainfall, is known as the Doldrums. At the Horse latitudes the upper currents corresponding to the trades and westerlies come into contact moving in opposite directions and are mutually compressed. The air naturally settles down to the surface of the earth, as a result of its increased density, which also increases its temperature and relative dryness. It is

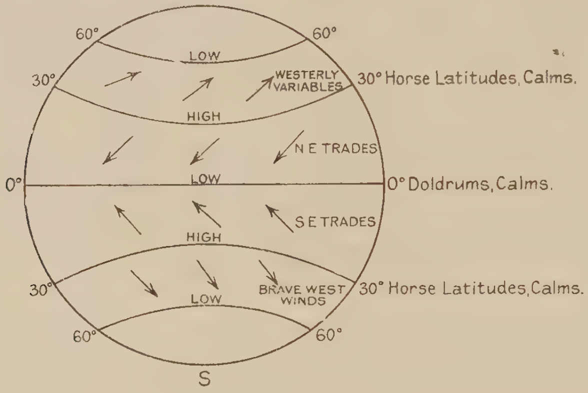
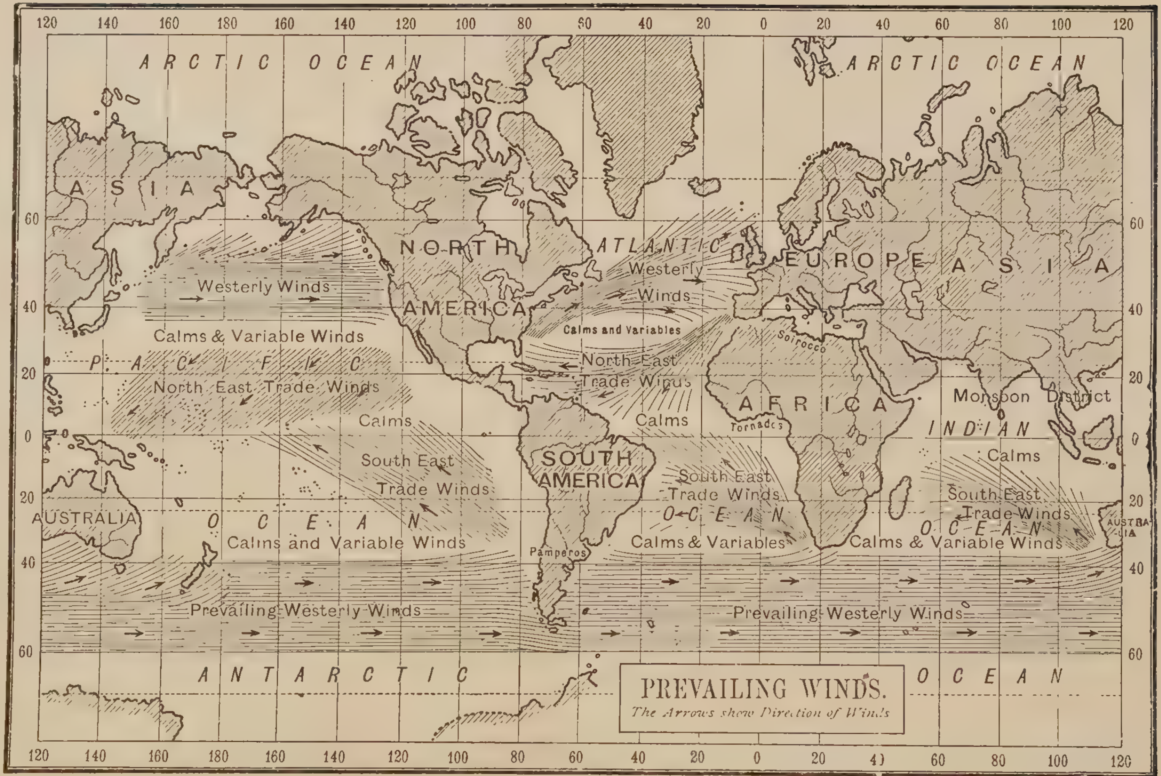


FIG. 2.—PERMANENT WINDS

noteworthy that most of the dry deserts of the world occur in or near the Calms of Cancer and Capricorn. " Calms " are not regions of absolute rest, but regions where no *permanent* winds occur and where *variable* winds may be caused by local variations of pressure. It is important to note that the hot equatorial low-pressure belt shifts northward in the northern summer when the sun's rays are more direct over the Northern Hemisphere, and southward in the southern summer when the sun's rays are more direct over the Southern Hemisphere. Hence, belts of low and high pressure and belts of " calms " and winds shift with the seasons. It follows that each trade-wind belt extends further towards the Pole in summer-time, and each westerly-wind belt extends further towards the Equator in winter-time.

MONSOONS. Monsoons (Arabic, " mausin," a season), the fairy godmothers of India, China, and Japan, are the chief *periodic* winds. In the northern summer the heat Equator migrates northwards, especially over the great land masses, and the plateaux of central Asia receive more heat from the sun than the waters of the Indian and Pacific oceans nearer the Equator. Now, since even an equal amount of heat is sufficient to raise the temperature of the land higher than that of the sea, it is clear that the summer of central Asia is very hot indeed. Into the low-pressure air created by the great heat, cooler air from high-pressure areas on the south and east flows. The north-east trades, which would otherwise blow over the Indian ocean, are entirely overcome; whilst the south-east trades are drawn across the Equator, and being deflected to the right blow over India from May to September as the south-west monsoon. Over lowlands this summer monsoon is a comparatively dry wind, but the western Ghats and the Himalayas by forcing it to expand into the upper air cause it to deposit a very heavy rainfall. In the western Pacific the trades being deflected to the right of their path blow over China as a south-east monsoon. In the southern summer, north Australia becomes a centre of high temperature and low pressure, while central Asia becomes a region of excessive cold and high pressure. The resulting monsoon blows over India from the north-east (September to May), over south China from the north, over north China and Japan from the north-west, and over north Australia from the north-west. Coming over the cold, dry



PREVAILING WINDS

land this monsoon is cold, dry and bracing, only becoming a " rain-bringer " when it passes over large expanses of water, as in the case of the rain-bearing north-west monsoon to north Australia. Smaller monsoon effects occur in the Guinea coast regions of Africa, Madagascar, Brazil, the south-eastern states of North America and Spain, and can be explained on similar principles.

Cyclones and Anti-cyclones. Owing to the unequal temperature of land and sea, the regular belts of high and low pressure shown in Fig. 2 are not continuous round the globe. Fig. 3 shows, by means of isobars taking the form of closed curves, a low-pressure and a high-pressure system side by side. The isobars are drawn at intervals of 10 millimetres, or about 0·4 inches. The left of the diagram represents a cyclone, into the low-pressure centre of which the winds blow spirally in an anti-clockwise movement, in the Northern Hemisphere, and a clockwise in the Southern Hemisphere. The ultimate result is the formation of an upward current of air above the central low-pressure area, which expands as its pressure decreases. This expansion is accompanied by cooling which causes condensation of its aqueous vapour in the form of rain, sleet or snow. The right of the diagram illustrates the phenomenon known as an anti-cyclone. In anti-cyclones in the Northern Hemisphere the air movements take the form of right-handed outward moving spirals (i.e. the winds move in a clockwise manner), and, settling

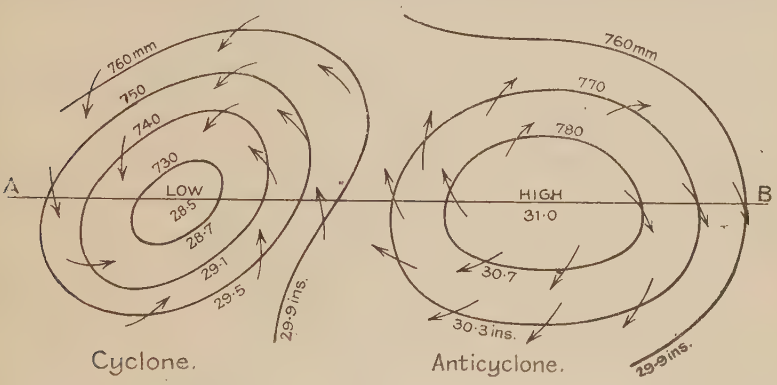


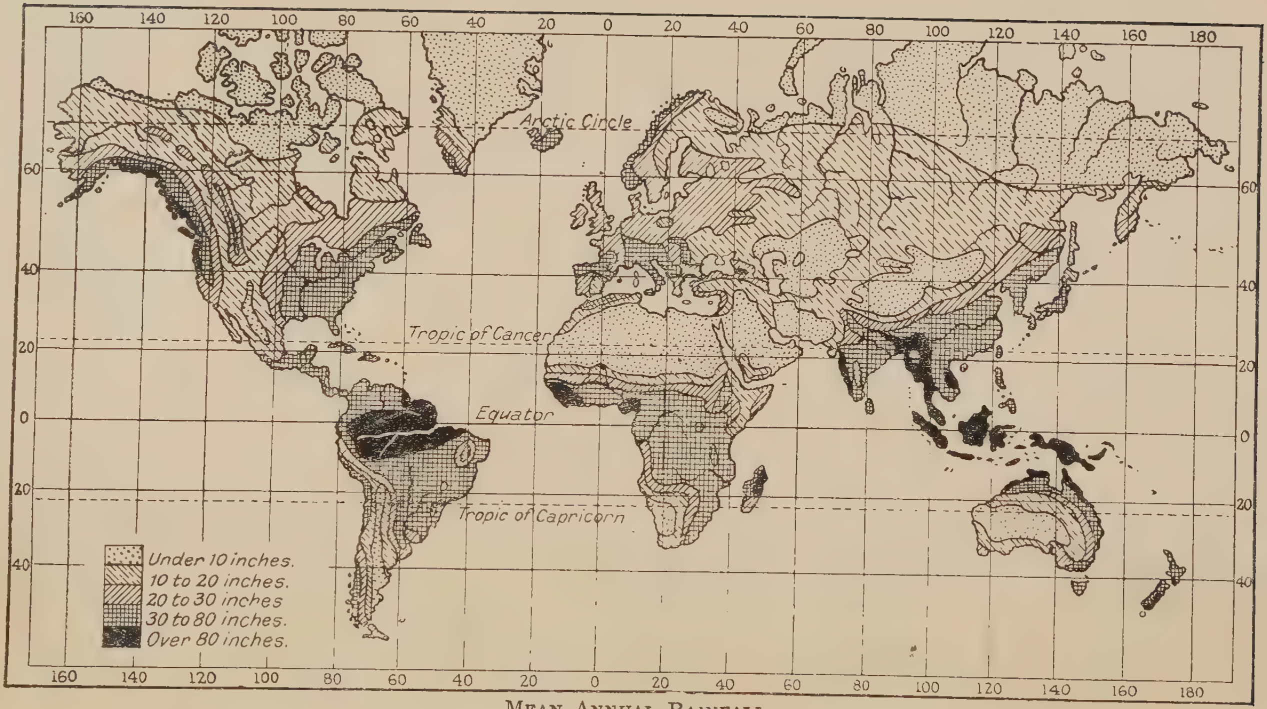
Fig. 3

Note: The unit of atmospheric pressure (international) is the millibar. The standard atmosphere = 1,013 millibars = a pressure supporting a mercury column of 760 mm.

downwards, the increase of pressure leads to increase of temperature and consequent dryness of the atmosphere. Between latitudes 35° N. and 60° N. cyclones and anti-cyclones frequently form, but the reasons of their formation, as yet, need further research. They travel slowly across the Atlantic along certain more or less well-defined tracks; and, though the average height of a cyclone is only about six miles, its superficial extent may be a thousand miles. It is said that on the average the weather of western Europe is under the influence of cyclones for more than 100 days in every year. The extreme changeableness of the weather of the temperate zones is to be attributed largely to cyclones and anti-cyclones, and when their origins and the exact weather conditions to be expected from each formation have been ascertained, agriculture and commerce will greatly benefit.

Rainfall. Water-vapour is present in variable quantities in the atmosphere, but cannot exceed a certain fixed limit, which is dependent on the temperature of the air. The higher the temperature the greater is the quantity of water-vapour which the air can contain. Thus, at –10° C. a cubic metre of air can hold 2·28 grammes of water-vapour; at 0° C. 4·87 grammes; at 20° C. 17·1 grammes; and at 40° C. 50·67 grammes. Air that contains water-vapour up to the limit of its capacity is said to be saturated. When liquid water is transformed by the agency of heat into water-vapour the process is called *evaporation*; while the reverse process, which liberates latent heat, is called *condensation*. Evaporation takes place if the air in the neighbourhood of a water-surface is unsaturated, and ceases when the air is saturated. Condensation takes place when air is cooled so that it can no longer hold all its water-vapour, and the temperature of the air when condensation begins is known as its *dew point*. The tiny particles of water-dust first formed collect round minute particles of organic and inorganic materials, and remain suspended in the air as clouds; but each tiny droplet forms a nucleus for further condensation, and when the drops become too heavy to be borne up by the air, they fall as rain. They do not always reach the surface of the earth, for in their downward course they may traverse a layer of dry, unsaturated air, and become wholly evaporated. If the air from which the water-vapour condenses is below freezing point, then instead of water-dust tiny ice crystals appear, numbers of which uniting form snowflakes, which fall to the earth. Rain is always caused by the cooling of air containing moisture, and is attributable to the dual influence of wind and topography. Modern meteorologists hold the theory that rain is caused, in practically every instance, by damp air being *thermodynamically* cooled by expansion brought about by its ascent from lower to higher levels. Anything which will cause the ascent of large volumes of air, if sufficiently persistent, will result in precipitation, provided the air is damp enough. The ascent of a current of damp air into the colder and rarer regions of the atmosphere causes the ascending air to be cooled not only by its passage into colder regions, but also by the expansion it experiences consequent upon the diminished pressure in the higher strata. Such ascending air currents, whether over the equatorial low-pressure belt or over the cyclonic systems of temperate lands, are the chief causes of rainfall. Mountain ranges, the edges of plateaux, or hills lying in the paths of winds, force the moving air to rise in order to cross the barrier, and *relief* rains fall, which are naturally heavier the higher and steeper the barrier. It is significant that $\frac{9}{10}$ths of the water-vapour in the atmosphere is contained in the lower four miles of the stratosphere. The total rainfall or precipitation of a place is considered to include all forms of moisture, whether rain, snow (10 inches of snow are taken to be equivalent to 1 inch of rain) or hail, which can be measured by the rain gauge. The object of all rain gauges is to collect all the rain falling on a known area, and store it in such a way that there is no loss by evaporation ; and the statement that the mean annual rainfall of a place is so many inches means that if all the rain which falls upon that particular place during a normal year be collected, the accumulated amount would be sufficient to cover the area to the depth of the number of inches indicated. The rainfall of the world may be mapped by drawing *isohyets*, or lines of equal rainfall, through places with the same mean rainfall, monthly, seasonal or yearly.

DROUGHT. The causes of drought are the reverse of the causes of rainfall. When air becomes warmer its capacity for holding water-vapour increases, and any water near it evaporates. It follows, therefore, that wherever air is being warmed, there it is dry, and neither clouds nor rain appear. Winds moving from



MEAN ANNUAL RAINFALL

cooler to hotter regions become dry winds, " water-drinkers " not " water-bringers." Descending air-currents are dry, for the pressure on them increases as they descend, and compression increases the temperature of the air, and this increases the capacity of the air for holding vapour. Regions of high pressure and regions under anti-cyclonic systems are, therefore, subject to droughts. It has been shown that the *windward* side of a barrier of high ground has usually abundant rain ; the *leeward* side, often called the *rain-shadow* area, is, however, usually dry, since the air current is descending. *Arid* lands are considered to have a mean annual rainfall of less than 10 inches, and *semi-arid* lands one of between 10 and 20 inches. These limits are, of course, arbitrary, for where soils are very retentive of moisture and the rainfall comes during the growing period, agricultural products can be raised with a small mean annual rainfall, the exact amount depending largely on the temperature.

The absence of sunshine may either make or mar the productivity of a region. Consistently cloudy skies in low latitudes protect the soils from too rapid evaporation, and so may make even porous soils productive ; while, in higher latitudes, the cloud screen by obstructing the sunshine may render soils too cold and moist for crop production. The intensity and the duration of sunshine are highly important to all forms of life. Research has disclosed the fact that much of the health value of sunlight resides in its ultra-violet rays.

Types of Climate. Perhaps the most generally satisfactory classification of climatic zones is that of Supan. The *Hot Belt* is bounded by the two mean annual isotherms of 68° F., a temperature which fixes approximately the polar limit of the trade winds and of palms. The polar limits of the *Temperate Belts* are fixed by the isotherm of 50° F. for the warmest month. The North and South Cold Caps (sometimes called Polar and Frigid) are regions where cereals and forest trees cannot grow, and where the warmest month has a temperature below 50° F.

EQUATORIAL CLIMATE. This type of climate of lands near the Equator (i.e. Amazon and Congo basins) is one of very high temperature and heavy rains throughout the year, and small mean annual range of temperature. On both sides of the equatorial lands are the *Tropical Belts* which have heavy rains at the season of the summer solstice when the heat is very great, and have a drier season at the winter solstice, when the heat is less great. Very similar to the tropical climate is that of *the tropical monsoon* lands (i.e. India and Siam) which are very wet during the season of the summer monsoon, and sometimes very dry during the season of the winter monsoon.

ARID CLIMATES. Over the greater part of the tropical zone the trade winds blow regularly from relatively cooler to relatively warmer regions. They remain dry so long as their course is over the sea or low-lying land, depositing moisture only when compelled to expand upwards by land barriers. Generally, it may be said that the eastern slopes of high lands in the trade wind belts have a heavy rainfall and luxuriant tree-growth ; low-lying lands and the western slopes are relatively dry, sometimes exhibiting desert conditions. More than half of the lands lying in the trade-wind and high-pressure belts consist of deserts. They include the Sahara, Central Australia, Kalahari, and Atacama deserts. Striking contrasts in rainfall are afforded by the heavily watered east coasts and the much drier west coasts of Central America, the West Indies, the East Indies, Madagascar and Ceylon. The coasts of Guiana and south-east Brazil have a heavy rainfall, while the Pacific coast of South America from 0° to 30° S. lat. is rainless, the inhospitable conditions being accentuated by the cold Peruvian current which bathes the shores. Other arid regions lie between the Brazilian highlands and the selvas of the Amazon, and leeward (i.e. westwards) of the mountain barrier of South-east Africa. *Arid* climates are found, therefore, in the trade-wind and high-pressure belts, and in the interior of the continents (i.e. Gobi desert of Asia). Owing to the dry conditions and lack of clouds, insolation is very great in arid regions ; the days are intensely hot, and the nights extremely chilly. Just beyond the tropics, on the eastern margins of the continents, are regions with hot, moist summers, and mild, sometimes dry winters (i.e. Central China and Eastern Australia).

MEDITERRANEAN CLIMATE. On the western coasts of the continents in latitudes approximately 28° to 40° in both hemispheres, owing to the migration of the equatorial low-pressure belt, the climate is controlled alternately by the trade winds (in summer) and the westerlies and cyclonic and anti-cyclonic systems (in winter) ;

and is characterized by hot, dry summers and mild winters, in which moderate and irregular rains alternate with the prevailing sunny weather. The mean temperature of the coldest month rarely reaches freezing point. This type of sub-tropical climate is often known as the *Mediterranean* climate, because it extends over a greater area in Southern Europe, Northern Africa, and eastward to Persia, than in any other part of the world. California, central Chile, and the south-western coasts of Africa and Australia are favoured with similar climatic conditions.

Temperate Climate. In higher latitudes than the "Mediterranean" lands are the regions with *temperate* climates, marked by seasonal variations of temperature rather than of rainfall. In such regions (i.e. the British Isles, British Columbia, Tasmania) the westerlies are the prevailing winds; the summers are cool and the winters mild; while relief and cyclonic rains fall at all seasons. Owing largely to the great preponderance of water over land in the Southern Hemisphere, the South Temperate Zone, as a whole, shows much smaller annual variations in temperature than the northern, and more strictly deserves the title, temperate. In this zone, moreover, the "brave west winds" are but little affected by cyclonic and anti-cyclonic whirls.

Continental Climate. In the interiors of the northern continents in the westerly wind belt a *continental* type of climate prevails with desert type in places (i.e. the Great Basin in North America.) The winters are severe, the summers hot, and the rainfall low, falling chiefly in summer, when the summer monsoon and cyclonic conditions are present. Only a little snow falls in the cold winter. Central Canada, the northern prairie states of the United States, and Siberia, are typical examples of regions with a *continental* or *steppe* climate. The coastal regions to the east of these continental regions, on account of their nearness to the sea, experience a heavier rainfall (chiefly due to cyclones), and a very heavy snowfall, which, acting as a blanket, protects the annual vegetation. Prevailing off-shore winds and cold currents along the shores make the winters very severe. Such moderated continental type of climate is found in eastern Canada and Manchuria. In spite of the great amount of solar heat received by the North and South Cold Caps at their respective summer solstices, their mean annual temperatures are the lowest known. The heat, acquired during the summer days of continuous or almost continuous (though weak) light, is required to melt the ice and snow (without raising the temperature), and is neutralized by the extent of the winter night. Even in summer it is never warm, and the winters are intensely cold. Rainfall is scarce, especially in winter, the air being so cold as to be capable of holding but little moisture. The slightly warmer winds of summer take up the increased amount of water evaporated then, but its precipitation, usually in the form of snow, quickly follows.

MOUNTAIN CLIMATE. *Mountain* and *plateau* climates differ from those of the lowlands in all parts of the world. The air is at a lower pressure and temperature; the surface of the mountain or plateau being more freely exposed to solar light and heat and to more rapid radiation, is, therefore, subject to greater ranges of temperature; and, generally, a more abundant rainfall occurs. Lofty mountain regions show many varieties of climate. In the equatorial zone at various altitudes there may be seen in succession a hot, moist equatorial climate; a warm moist climate; a cool climate; and the polar Arctic type. It must be remembered that climate changes very gradually from one type to another, and no exact limit can be fixed between one type and its neighbour. Many regions have climates intermediate between the important types which have just been described.

The Influence of Climate. No geographical factor has had a greater influence on the history of the different races of mankind than climate. It is of prime importance in man's clothing, dwelling, food, occupations, and customs; his physical and mental characteristics; his systems of government; and his industry and commerce. The most important climatic factors are moisture and warmth, for they are the primary essentials to all that life—both vegetable and animal—upon which human existence depends; and, hence, temperature and rainfall are among the most important natural assets of a country, because of their influence upon its productivity. Heredity may account for many racial traits in man, but climatic control is seen in the adaptation of the black race to the tropics, the yellow race to the monsoon lands, and the white race to the temperate zones. Climate helps to make the soil, and decide its type; influences its productivity; and, ultimately, decides soil-utilization. Transport is affected by winds, temperature, and rainfall; mining is often dependent on temperature; textile manufactures are aided by a humid atmosphere; and man's capacity for commerce is greatest in temperate regions, where the climate fits and urges him to action, creates the instinct towards betterment of condition that leads to the conception of the value of labour and, finally, it is in such regions that man shows a tendency towards profitable specialization. Man is physically most active when the mean temperature is 60° F. to 65° F., and mentally most active when the outdoor temperature is about 40° F. All human progress depends upon activity of mind and body, and hence the dwellers in certain temperate regions dominate the world. Much of Britain, the neighbouring parts of Europe, and the eastern sea-board of the United States, are regions where winter cold stimulates the brain of man; warm summers give him a physical stimulus; and small variations in climatic conditions act as a tonic to his system. Man in temperate regions has trodden the Via Dolorosa, and gained thereby spiritual and material rewards. Arnold Guyot says: "In the temperate zone all is activity—movement. The alternations of heat and cold, the change of seasons, a fresher and more bracing air, incite man to constant struggle, to forethought, to a vigorous employment of all his faculties. A more economical nature gives nothing except to the sweat of his brow; every effort on her part is a recompense for effort on his. . . . Incited to labour by everything around him, he soon finds in the exercise of his faculties at once progress and well-being." In certain tropical regions, where climatic conditions lavish food and wink at the neglect of clothing and shelter, ignorance, superstition, physical prowess and sexual passion reign supreme over intelligence, foresight, thought, and self-control. Man in such regions will remain backward in his intellectual and strong in his animal nature, until the technique of cooling has been perfected.

CHAPTER III

THE DISTRIBUTION OF NATURAL VEGETATION AND OF ANIMAL LIFE

> "The Spirit of God is around you in the air that you breathe, His glory in the light that you see, and in the fruitfulness of the earth and the joy of its creatures He has written for you day by day His revelation, and He has granted you day by day your daily bread."—*Ruskin.*

(*a*) **NATURAL VEGETATION.**—No part of man's organic environment is in closer relation to him, or controls more his occupations and life than vegetation. Plants are factories in which food for all other forms of life is manufactured; and, probably, the first evidences of life were minute plants. Luxuriant plant life, enriched with wealth of glorious flowers, uplifts the human mind, and by its resurrection gives eternal hope to the human soul. Every plant is an expression of the combination and interaction of three forces—the seed, the climate, and the soil (or other medium)—and requires for its mature development an indispensable minimum of food, sunlight, moisture, and heat. Different plants require varying conditions of these essentials, and each part of a plant has its own partialities. Being plastic and adaptable, plants have developed various forms of growth to meet all conditions of their environment.

The Function of Plant Life. In some way, as yet imperfectly understood, green plants feed at a very low chemical level, on carbon dioxide gas, water, and salts. They have the unique power of building up protoplasm, the "physical basis of life," from simple inorganic matter. The green leaves obtain carbonic acid gas from the air, and the root-hairs absorb water containing dissolved mineral salts from the soil. In the leaf-cells the up-building of food takes place. Embedded in the living matter are numerous biscuit-shaped green bodies (chlorophyll corpuscles), whose function it is to transform and absorb the light energy. The chlorophyll corpuscles, utilizing the energy of sunlight, construct complex carbon compounds from the food obtained from the air and the soil, and by their action liberate and expel oxygen. They convert the kinetic energy of the sun into the potential energy represented by the chemical products. Man is the child of the sun, for much of its energy reaches him through plant life. The formation of the carbohydrates is the fundamental process of plant nutrition and of life in general, for all other organic compounds in colourless plants, animals and man are derived from them. Next to moisture, light is the most important external factor affecting the form of plants, as it largely controls plant structure. Where light is too weak, as under the dense foliage of equatorial rain forests, plants become long, lank, weak and pale. Moderate light favours the formation of large, thin, dark green leaves. Strong light, such as that on exposed mountain heights, produces stunted plants, with small, thick, grey leaves, and brilliantly coloured flowers. Many exhibit the rosette habit of growth as in the saxifrages. Excessive light destroys the chlorophyll, so that the leaves of plants in countries bathed in sunlight move with the sun, erect or drooping, presenting their edges only to its rays. In high latitudes the continuous summer sunlight induces an intense and rapid growth of plants, so that barley ripens in 89 days in Finland and some Canadian wheats mature in less than 90 days. The increased production of pigment in flowers and fruits, as well as the ethereal oils, in higher latitudes, is probably correctly attributed to the increased hours of sunshine during plant development.

The Importance of Humidity. Humidity determines the type of vegetation. It is the first requisite of plant life, and depends partly on the physical conditions of the soil. Clayey soils are extremely non-porous and retentive of moisture—an advantage to plant life in a hot, dry climate, but a disadvantage in a cold, wet one. Plants obtain their mineral food chiefly from the soil, so that soil-fertility is important. Sandy soils are usually deficient in plant food, while volcanic soils are usually very fertile. Loams and marls are generally the most favourable soils for vegetation, but their value varies with climatic and other factors. Light soils do not allow plants with strong roots to secure anchorage, and are, therefore, not suited to forest growth. Water penetrates the earth to great depths, and, where there is abundance, forms a film around each particle of soil. This hygroscopic water, containing dissolved salts is, by the process of osmosis, taken in by the root-hairs and distributed to the various parts of the plant; and a current in the opposite direction distributes elaborated food to the regions of growth and storage. Water gives the stalk and leaves rigidity, and the distended condition known as *turgor*, without which normal growth would be impossible. It maintains the protoplasm in the characteristic semi-fluid condition which is essential to the exercise of its vital functions. Absence of sufficient water-content may cause the death of the protoplasm. Even if the protoplasm is able to tolerate comparative desiccation, it is compelled to pass into a condition of suspended animation. The leaves of plants generally have numerous little holes (stomata) in the epidermis or skin; on aquatic plants they are particularly numerous on the upper side of the floating leaves; in non-aquatic plants on the under side. Through the stomata water-vapour and oxygen flow out and carbon dioxide flows in. The danger of becoming too dry is, on the whole, the greatest which plants, in general, have to confront. Whenever green plants are exposed to light they lose moisture in the form of water-vapour in the process of transpiration. So long as an abundance of water can be obtained from the soil to replace the loss, free transpiration has no ill effects; but it becomes highly dangerous if, for any reasons, the roots are unable to supply enough water to keep pace with it. Actual drought or physiological drought (moisture being present but not available to the plant) may arise from lack of water in the soil; the presence of salts or organic acids in the soil which interfere with the absorption of water by the roots; and the chilling of the roots in a cold, moist soil which has a similar action. Trees and shrubs, which have no other means of limiting the transpiration sufficiently, resort to the complete sacrifice of all their leaves at the commencement of the cold season, and are called deciduous. Soft stemmed (herbaceous) plants lose all parts above the ground. Plants adapted for life under physical or physiological drought are known as Xerophytes. They are slow breathers and limit their transpiring surface by either total leaflessness or modification of their leaves. The evergreen coniferous trees—pines and firs—have thick, tough, leathery, needle-shaped leaves, and their stomata are sunk in pits or depressions, so that they are not fully exposed to the air. When the leaves are larger, they are stiff and horny as in the monkey-puzzle tree. In the cypress the leaves are small and scale-like, and photo-synthesis is performed by both leaves and stem. Hairiness, spinescence, varnishing, and waxiness, typical of desert plants such as the cacti, and of plants on exposed mountain heights as the edelweiss, help to conserve moisture, resisting transpiration by day and collecting dew by night. Many Xerophytes are succulent, storing water in their stems for future need, and by remarkably extensive and deep root-systems search the ground thoroughly and effectively for the requisite moisture. Hygrophytes are plants growing in regions where abundant moisture is available for their growth ; they have broad-bladed leaves, sometimes provided with dripping points, and have other devices for ridding themselves of any excess of moisture. Plants characteristic of climates, which show no extremes of wet and dry, or of hot and cold seasons, are called Mesophytes. They are fitted for average conditions of water-supply, and flourish in British woodlands and meadows.

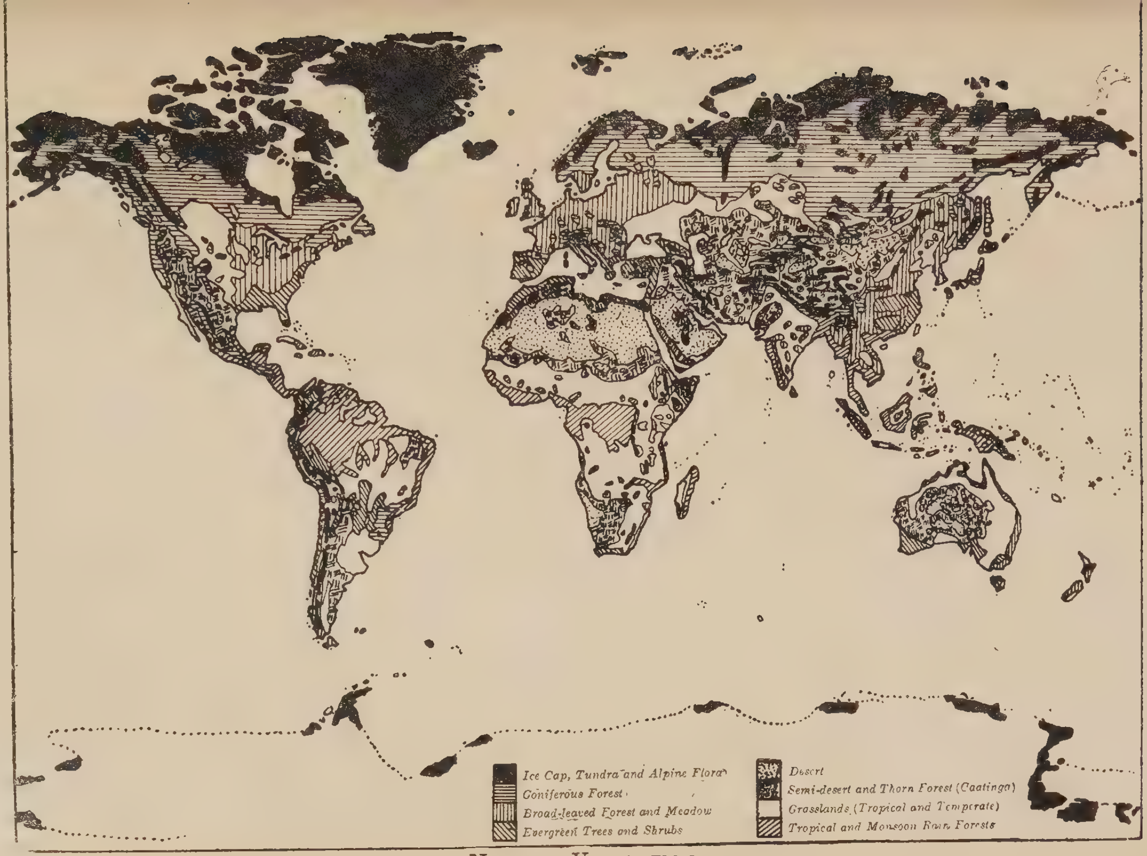
The Importance of Temperature. It is generally conceded that temperature and humidity are the chief factors governing the distribution of life, and that temperature is more potent than humidity. Upon humidity depends the type of vegetation, but it is heat to which plants owe their growth. Every plant lives between two temperatures, above the upper of which or below the lower it cannot continue to exist for long. The actual temperature at which a plant begins to carry on its functions varies with different species, and the climatic conditions to which they have been subjected. Some species of the lower forms of plants will grow at or slightly below freezing point, while date palms make little or no growth below 64° F. (18° C.). It is believed, however, that 42·8° F. (6° C.) marks the temperature below which most field and garden crops will make little, if any, development. Plants develop best with a certain sequence of temperature ; each requires its own requisite of heat before it can germinate, open its leaf and flower-buds, or flower and fruit. Excess of heat or cold is not in itself inimical to plant growth. Desert plants live at temperatures of 120° F.(49° C.) or more, and Antarctic mosses at −90° F. (−68° C.). But, given other favourable plant factors, plants generally grow more luxuriantly with greater spread of foliage in warmer climates than in cooler climates. Heat and humidity are intimately connected in their effects on plant life. Their primary importance lies in determining the amount of moisture available for plant utilization ; and, on the amount available, the growing and resting periods in plant life depend. The storage of food in bulbs, stems, tubers, or seeds, is bound up with the habit of evading cold and drought by passing into an inactive resting stage ; and plants are then enabled to make a flying start when climatic conditions become more favourable. In all parts of the world where the relation between temperature and rainfall permits moisture to be always or nearly always available in the soil for plant-utilization, perennials represented by trees are the natural vegetative type. Where moisture is too deficient for plant-existence during some season or seasons of the year, the plants germinate during the moisture period, and pass through the various processes necessary to produce seeds capable of retaining their vitality under extreme climatic conditions ; while they, themselves, succumb, when their environment becomes too severely hostile. The annual type of vegetation thus prevails, the grasses, cultivated and wild, being the characteristic members. Regions possessing the sparest vegetation are the dry deserts, which have insufficient moisture in relation to the temperature ; and the cold polar deserts—physiologically dry except in the brief summer—where most rigorous temperature conditions almost prohibit plant life.

Plants are affected for good or ill by their neighbours, both vegetable and animal. The beech shelters the tender wood anemone ; worms, insects, and bacterial life improve the soil ; birds and insects fertilize flowers, aid in the production of seed, and are not infrequently destructive agents ; and man acclimatises and breeds plants suited to various environments, and sometimes, as by the cutting down of forests, he has upset nature's balance, much to his detriment. Winds check or prevent tree growth by their violence or by causing too rapid transpiration. They transport moisture and bring fresh supplies of carbon dioxide to plants ; they disperse seeds and fertilize trees by transported pollen.

Vegetation Zones. Plant associations—forest, grass and desert—have a direct relation to the great climatic zones. In the ever hot (70° to 85° F.), ever wet equatorial regions, where the rainfall is at least 70 inches annually and the air is often calm, the subsoil is permanently moist; the soil is remarkably fertile; and bacterial action is at its maximum.

EQUATORIAL FORESTS. Such conditions produce on flat or rolling plains or the lower slopes of mountains up to 3,000 ft. the *Equatorial Ever-green Rain Forests*, the supreme effort of plant life—solid masses of vegetation from 100 to 200 ft. high. Giant trees, straight trunked, and laced together by creepers or lianas, from which hang numerous epiphytes, struggle towards the light and air; while the undergrowth forms a miniature forest wherever the light can penetrate. A sombre darkness fills the forest aisles, for the thick foliage is scarcely penetrated even by the beams of a tropical sun. So dense is the undergrowth that often these forests can be penetrated only by means of the waterways. Jack London, in *Adventure*, gives a wonderful word-picture of this sea of plant life. "They plodded on panting and sweating in the humid stagnant air. They were immersed in a sea of wanton, prodigal vegetation. All about them the huge-rooted trees blocked their footing; while coiled and knotted climbers of the girth of a man's arm were thrown from branch to branch or hung in tangled masses like so many monstrous snakes. Lush-stalked plants, larger leaved than the body of a man, exuded a sweaty moisture from all their surfaces. Here and there, banyan trees like rocky islands shouldered aside the streaming riot of vegetation between their crowded columns, showing portals and passages where all daylight was lost and only midnight gloom remained. Tree ferns and mosses, and a myriad other parasitic forms jostled with gay-coloured fungoid growths for room to live, and the very atmosphere itself seemed to afford clinging space to airy fairy creepers, light and delicate as gem-dust, tremulous with microscopic blooms. Pale-golden and vermilion orchids flaunted their unhealthy blooms in the golden dripping sunshine that filtered through the matted roof." The great variety of trees in the hygrophilous selva is difficult to realize. Prof. I. C. Russell says: "There are probably more species of trees in 100 square yards in a tropical lowland forest than in 100 square miles in a forest of central Canada." Vegetation is active throughout the year. There is no definite period during which the spent-out leaves are shed, for new leaves are always forming at the tips of the branches, while the older ones lower on the stems are always dying and falling. At any period of the year some trees are bursting into leaf, others shedding their leaves, others gay with brilliant flowers, and others bearing fruit. The large delicately-formed leaves are adapted to throw off excessive moisture, and are very mobile, following the sun in its daily course, drooping, expanding, or rising, as necessity dictates. Among the most important economic trees and plants found in these forests are the various rubber and gutta-percha vines and trees; the valuable hardwoods—mahogany, lignum vitae, sandalwood, and rosewood; the dyewoods—logwood and brazil-wood; the prolific banana and plantain plants; the baobab, bamboo, and cinchona tree; and numerous varieties of palms. Dense rain forests stretch across Africa in a band from 100 to 200 miles broad on the north of the Gulf of Guinea, and then broaden to cover most of French Congo and Belgian Congo to the Great Lakes. In South America they extend over the basin of the Amazon (Amazonian selvas) and fill the valleys of other Brazilian rivers. Similar forests are also found skirting the coast lines of the Malay Peninsula and Archipelago; the coastal regions of Madagascar and East Africa, between the Equator and the southern tropic; and in Assam, Bengal, and Burma. In the secondary forest which springs up where the primeval forest has been cleared, oil palms and sago palms flourish; and in the more favoured localities plantations of wonderful luxuriance yield manioc, rice, arrowroot, vanilla, sugar, coffee, cacao, tobacco, cloves, nutmeg, and ginger.

Equatorial forests in their lower regions are almost devoid of animal life, but the upper roof garden bustles with animal life adapted to tree conditions, brightly coloured, plumed or furred, wholly invisible from below. Human development is greatly retarded. Hunting, fishing, and collecting of natural products, all involving nomadic life, are the chief occupations. Agriculture is at a minimum. Primitive tribes—Papuans, Pygmies, and aboriginal Indians—scattered over immense areas, are the permanent dwellers. Civilized man has touched the fringes in his clearings; but is compelled to wage eternal war with nature, for without constant vigilance and effort on his part, the forest rapidly regains its own. Man needs the technique of cooling, immunity from bacterial diseases, and power to utilize the unestimated and enormous stores


Ice Cap, Tundra and Alpine Flora
Coniferous Forest
Broad-leaved Forest and Meadow
Evergreen Trees and Shrubs
Desert
Semi-desert and Thorn Forest (Caatinga)
Grasslands (Tropical and Temperate)
Tropical and Monsoon Rain Forests

NATURAL VEGETATION

of plant energy, to cope successfully with the powerful forces of the forest.

Wooded swamps border the low estuaries and shores of many equatorial forest belts. Their impressive aspect and deadly properties have earned for them the name *Mangroves*. Alternations of heavy rain and scorching sunshine, salt or brackish water, rotting mire, and the rhythmic tidal flood are the conditions of life. At high-tide the mangrove seems a mass of green, grey, or dull blue foliage resting on the water. When the tide recedes it is revealed as a low forest of ungainly tree weeds. Mangrove plants are evergreen, and adaptation to the slow absorption of moisture is shown in the nature of their leaves, which are either thick and leathery, fleshy, provided with a glossy impervious skin, or with a woolly down. Their unshapely trunks and branches, soft and juicy, store up water; and their roots by means of a spreading scaffolding of stilts or buttresses fix the trees in the soft, reeking slime. Uninhabited and extremely unhealthy, mangroves serve only to protect the true coastal land beyond.

Monsoon Forests. In the true tropical monsoon regions in India, Burma, Indo-China, and northern Australia, and on the margins of the equatorial rain belt in Africa, round the shores of the Gulf of Mexico and the Caribbean Sea, and the north and eastern portions of South America, a large variety of forests and woodlands exists, subjected to one well-marked season of drought (four to six months), a hot climate, abundant summer rains, an annual rainfall of sixty to seventy inches or more, strong desiccating winds in the dry season, and a more strongly marked difference of temperature between day and night, and between hot and cool seasons, than in the rain-forest belt. These forests are termed *Monsoon Forests*, and differ greatly in appearance and composition, varying from the high bush (30 to 40 ft.) to the lofty type (100 to 150 ft.). More open than the rain forest, the struggle for existence is less keen, and more light pervades the forest to aid the undergrowth of thickets of woody shrubs or tall tufty grasses. Though over wide areas trees are often of the same species, the variety of tree species is remarkable, some forests containing forty or fifty kinds of trees. Vegetation shows a well-marked periodicity, especially in the teak forests of Java, the Malay Peninsula, and

Burma. The trees are tropophilous (alternately hygrophilous and xerophilous) in character, many of them distinctly deciduous, and the landscape in the dry season has a wintry aspect. Trunks and branches are stout, the latter starting at no great height. The leaves are thin and simple, sometimes very large, as in the teak. Lianas and climbers are fewer than in the selvas, and epiphytes occur only in the canopy.

Less awe-inspiring and overwhelming, the monsoon forests are healthier, more easily cultivated, and more favourable to human settlements than the hot rain forests. On the rich plains of the monsoon lands tropical agriculture is of great antiquity. Maize, millet, rice, sugar, banana, coffee, tea, cotton, indigo, jute, and wheat and barley (in the dry cool season), are all cultivated, sometimes under irrigation. The forests yield teak, sal, mahogany, logwood, the oil palm, the kapok tree, and the shi-butter tree. Probably some of the rich agricultural regions now supporting dense populations are clearings of the forest.

THE CAATINGA. A low type of tropical woodland, the *tropical thornwood* or *caatinga*, of varying aspects—close jungle, park-like formation, close treeless bush, and open formation with patches of bush and cacti—is found in north-eastern Brazil, Mexico, and Central America, the Lesser Antilles, Venezuela, and the Guianas, western and eastern Sudan and East Africa, parts of the Deccan, and the hinterland of northern Australia. The environment includes a long dry season (six to eight months), a short rainy season with irregular rains coming frequently in storms, an annual rainfall of sixteen to forty inches, a high temperature all the year round (59° to 95° F.), strong sunlight, an active and continuous evaporation, and soils poor and often permeable. Under such conditions, plants lead a dormant life for the greater part of the year, awakening to wonderful activity during the time of scanty rains. Growth is slow, and vegetation stunted. The rhythm of life is more strongly marked than in the monsoon forests. Plants first flower, then leaf, ripen their fruit, build their leaf-buds, shed their leaves, spread their seeds, and then assume a dormant state. Occasionally, stems and branches, furnished with green matter, manufacture the plant food ; and leaves are often either thick or leathery ; covered with wax, resin or gum ; or divided into leaflets which spread or contract easily, responding to the sunlight. Only plants with strong branching and penetrating roots and with reserves of food and water can survive ; grasses with shallow roots have little chance of survival. In the dry season the tropical Caatingas appear as grey, bare, and tangled jungles of low thorny tree-bushes, 10 to 15 ft. high, interspersed with prickly candelabra cerei, acacias, and cacti, and dotted with barrel-shaped trees resembling huge water-bags. At the onset of the rains, the dead-looking scrub becomes a sea of fresh verdure, glorious with gorgeous perfume-laden flowers. Barren and almost useless, the Caatingas are very sparsely populated. In some parts of Brazil and East Africa they have been replaced by coffee plantations, and in Mexico the fibre-producing agaves are now exploited.

THE SAVANNAS. Savanna forests with xerophilous trees, scattered widely and interspersed with tall grasses, exist in tropical regions where a moderate range of temperature, occasional desiccating winds, an average yearly rainfall of from 40 to 70 inches spread over 120 to 190 days, a soil not too permeable, and a prolonged period of drought (four to seven months), are found. Savannas include the parklands of Africa (in the Sudan and East African highlands, and round the Kalahari desert as far south as Natal), the Venezuelan *llanos*, the Brazilian *campos*, and the Australian *downs* ; and they occupy a circular belt around the central desert of Australia, some of the drier parts of India, Further India, East and Central America, and the high-lying regions of the East Indies and Madagascar. The Savanna is primarily a grass land, but its grasses, nevertheless, differ from those of English meadows. They exhibit a green aspect during the rainy season, when they spring up rapidly in great clumps to the height of six to ten feet ; but become dry, bare and lifeless during the dry season, showing at intervals patches of bare, parched soil. Under the best conditions of water supply, as in the hollows, woods are found ; but the trees are drought-resisting, and many have a remarkable capacity for storing water. Common types are the baobab, mimosa, acacia, ceiba, eucalyptus, tamarind, sycamore, and various palms. Noteworthy are the umbrella-shape of many of the trees which act as a wedge against the wind, and the sponge-like character of the roots of the grasses, and the accumulated straw of previous years which checks evaporation. Tubers and bulbs are common, adding beauty to the landscape in the flowering season.

The savannas are eminently fitted for animal life; and numerous herds of such big game as the antelope, zebra, buffalo, giraffe, elephant and rhinoceros, feed on the grass and trees. They offer to man great opportunities for hunting, cattle-breeding, agriculture, and trading. Though now almost wholly pastoral regions, the savannas are destined to become the most productive and populous lands in the tropics. The seasonal drought forces the inhabitants to be industrious and thrifty; and agriculture is favoured (at least, in the better-watered parts) by the absence of forests.

TROPICAL SCRUBLANDS. Tropical scrubs or semi-deserts form a transition between the deserts proper and the savannas, or between the deserts and the caatingas. The environment is best described as intermediate between the tropical Sahara desert and the caatinga. Rain falls very occasionally; the temperature is high all the year round; great variations of heat and cold occur; and soils are often gravelly, pebbly, or sandy. Grass is sparse and low; the umbrella-acacia dwindles to a mere shrub, bare for most of the year; bushes and low trees are widely scattered; and tubers are numerous. Among the various types of scrub are the thorny cacti of Arizona, the succulents and dwarf acacias of East Africa, the creosote bush wastes of Mexico, the yucca and agave of Texas, the mulga scrub of Australia, the euphorbia barrens of Sokotra, and parts of the South African Kalahari desert and Karroo. The *espinal* scrub, in its most forbidding form known as the *chañaral*, is sub-tropical; and ranges from low woods to bare stony flats, dotted with spreading thorn bushes and candelabra cacti. It is well developed along the Andean foot-hills in Argentina and Chile. Only the hardy camel and swift ostrich live in such regions; human settlement is almost prohibited. The chief economic products obtained are certain valuable gums and resins used in perfumery, yields of the dwarf acacias.

DESERT. The environment of the *true desert* includes an absence or rarity of rain (sometimes a single shower in many years), an excessively dry and clear atmosphere, clear skies, a great range and sudden changes of temperature, boundless wastes of yellow sand-dunes, broken and rugged stony floors, and ruined scarps of naked hills standing out sharply against a deep blue sky. Under such conditions plant life is either in scattered discontinuous colonies, or is wholly absent, as in areas of shifting sand-dunes. Floras are all local adaptations of migrants from more humid regions, except, perhaps, the cacti and torotes. Desert trees and shrubs are either leafless or are furnished with very small leaves, the thickened stems of the plants in the former case serving such respiratory function as is absolutely necessary. The insurgent nature of plant life is wonderfully exhibited. Plants sprout, grow, fruit, and seed within two or three weeks; their hard, dry seeds live for years in the dormant state; their roots reach astonishing depths; and every device for retaining, storing, and obtaining moisture is in evidence. Typical of the inner desert are the various species of cacti, the thick fleshy stems of which hold stores of water, while their spines (which take the place of true leaves) make transpiration very slow. Very fleshy species of euphorbia, and the grasses called esparto, or halfa, are also typical. Barrenness is often solely due to lack of rain. Most desert soils have retained their plant food, and are remarkably fertile. Where moisture is available the desert yields its quota of beauteous and rich vegetation. Given a permanent water supply from wells or rivers, the desert shows cultivated oases of varying extent from the date-palm groves, which mark the trading routes, to the long oases of the Nile, Euphrates, Indus, and the Amu and Syr-Daryas, which yield all varieties of tropical and sub-tropical products. The merciless overwhelming light, the awe-inspiring silence, and the soul of the desert are well portrayed in the following description, given by a traveller in the Libyan desert: "At the solemn majesty of the wilderness every sound is hushed; over the boundless yellow surface broods a shimmering refracting atmosphere heated by the mid-day sun, against whose impressive glare the eye in vain seeks relief in some shady nook. More vividly even than the sea, the solitude produces the impression of limitless space, its very grandeur stimulating to reverie, and awakening feelings of awe and devotion."

Old-World deserts, tropical and extra-tropical, passing into acacia scrubs on the equatorial side and to poor steppes on the polar side, stretch almost continuously from Mongolia to the African shores of the Atlantic, embracing the great Sahara with its stony, pebbly, gravelly, and sand-dune aspects; the Arabian with its vast seas of moving sand and wastes of stone and lava; the wormwood wastes of the Caspian; the saxaul and tamarisk heaths of Iran and Turan; the partly reclaimed Indus desert; and the bare, moving sand-dunes of the desolate Gobi or Shamo, remarkable for their great winter cold. Other deserts include portions of California, Arizona, and Mexico, noteworthy for the extraordinary development of fleshy, thorny, and often leafless succulents; the frequently mist-veiled coastal deserts of Peru, Chile, and South Africa; and the Great Central Desert of Australia, marked by its few oases.

For a brief space man may dominate the desert, but it eventually claims its own. Only on the oases is permanent habitation possible; elsewhere both man and animal must be nomadic and rapid in motion. The date-palm in the oases, and the camel on the road, are two essentials of human life in the desert. It is believed that the uniformity of the environment, and the solitary meditative life of the desert dwellers, led to the belief in the unity of God, and provided good soil for the growth of Mohammedanism.

SUB-TROPICAL OR WARM TEMPERATE RAIN FORESTS. These occur in regions possessing mild temperatures with annual averages of 50° to 70° F.; a moderate to abundant rainfall all the year round (60 to 120 inches falling on from 90 to 180 days, and with no marked dry season); fairly deep, fresh, rich soils; and no prolonged dry winds. They are found in the lowlands of the southern states of the United States from Cape Hatteras to eastern Texas; in south Brazil, and the higher valleys of the Paraná, Paraguay, and Uruguay; in central and south China, north-east India, and Burma; in the eastern coastal districts of Australia; in Tasmania, and New Zealand; and in the narrow hilly strip along the African coast from Mossel Bay to Algoa Bay. On highlands, they occur on the slopes of equatorial mountains at altitudes above 3,000 ft., and at lower altitudes in sub-tropical climes. They are well developed in east Mexico, Central America, the Andes from Colombia to Tucuman, equatorial Africa, Chile, Assam, Borneo, Indo-China, central and south China, Formosa, Malaya, and south Japan. The trees differ from those of the tropical rain forests in their lesser height (except the eucalyptus), greater spread of crown, stouter and more complex structure, less intensity of life, lower branches, more scattered formation, less number of species, and fresher foliage. There is a sharper distinction between summer and winter aspects than in the equatorial type, though the uniformity of the climatic conditions throughout the year results in the lack of a definite seasonal rhythm in plant life, trees being found at all times of the year in their green and their bare stages, in flower and in fruit. Many trees are evergreen, and the leaves are usually smaller than those of the tropical rain forest, and are simple, oblong or oval, somewhat thick and leathery, and glazed on the upper surface. Tree-ferns, palms, bamboos, and numerous shrubs and lower trees form a second tier to the forest, and the spaces between the tall trees are occupied by a dense undergrowth. Lianas are rare, but herbaceous climbers and epiphytes are numerous. The tangle of shrubs and climbers and the litter of decaying vegetation make the forests very impassable. Among the various types of trees, evergreen, deciduous and coniferous, are the eucalyptus, kauri, white and yellow pine, maple, laurel, cypress, magnolia, chestnut, sycamore, oak, gingko, beech, incense, tea, and kahikatea. Economic products from the forests and the forest clearings include valuable timbers (kauri and eucalyptus), gum, cinchona, camphor, tea, some kinds of rubber, coca, gutta-percha, yerba maté, cotton (the bulk of the world's crop), tobacco, rice, mulberry, maize, wheat, millet, sugar cane, indigo, ramie fibre, and the opium poppy.

Supremely favourable to human settlement, the clearings of the warm temperate rain forests show old, prosperous and civilized agricultural nations in the monsoon lands of Asia; and in New Zealand, New South Wales, Chile, and the southern states of the United States a modern agricultural development by peoples of European races. In no other large natural region of the world can the predominating influence of agriculture on the manners, customs, social organization, morals, religion, arts, and poetry of a race be traced so clearly as in China.

MEDITERRANEAN WOODLANDS. Under the name *Mediterranean Woodlands* are included dry evergreen (or ever-grey), hard-leaf forests, woods, and shrubs. The environment comprises an annual average temperature of 50° to 70° F.; a much greater range, both daily and seasonal, than in the warm temperate rain forest; snow and ice at intervals in winter; three or four months of hot, dry weather, broken only by occasional storms; an irregular rainfall varying from 20 to 40 inches, falling chiefly in heavy showers during the short mild winter; and many types of lands—broad, sandy flats, rich alluvial plains, downs, marshes, rocky scarps, and hill— and mountain slopes. Typical "Mediterranean" vegetation is displayed north of the desert belt in California, in the bordering lands of the Mediterranean Sea, in the south-west of South Africa, in south-western Australia, and in the valley of central Chile. Plant growth is slow but continuous throughout the year, no season being sufficiently unfavourable to make plant life entirely dormant, nor sufficiently favourable to stimulate intensely active growth. Small-leaved, leathery, evergreen foliage, low stature of the trees, high proportion of wood to leaf, and development of thorns, prickles, resins, wax, and essential oils, are all answers to the problem of conservation of moisture; and deep roots are the means of obtaining sub-soil supplies of moisture. Among the various types of plant landscapes are scattered and open woodlands of cork-oak, oleander, myrtle, olive, carob, orange, terebinth, fig and rosemary; coniferous forests of pines, firs, cedars, junipers, and cypresses; light forests of deciduous oaks; extensive wastes covered by dwarf palm bushes; scattered thickets of stunted, bushy, prickly evergreens; and dense scrub, six to ten feet high of mixed deciduous and evergreen bushes, known as maquis, wherever the forest has been destroyed and the soil neglected. Forest trees vary with the rainfall. On the wetter lands the walnut, manna oak, chestnut, and plane tree thrive; on the drier, evergreen oaks in scattered open glades. Underground bulbs and tubers—asphodels, anemones, tulips, narcissi, and gladioli—which beautify the landscape, often occur; narrow-leaved heaths and sweet-smelling herbs are numerous; palms reach their poleward limit and smallest size; and pasture, rich only at great elevations, is generally sparse, in the driest regions, being represented by esparto, alfa, and delta grasses. The olive tree, by means of its small evergreen leaves, deep roots, and gnarled trunk with low branches, shows perfect adaptation to its environment, and yields an oil which takes the place of butter, thus compensating for the poor supply of milk in "Mediterranean" lands. The sunny summers and mild winters greatly favour the growth of fruits; and grapes, lemons, oranges, plums, apricots, pomegranates, figs, pears, peaches, filberts, butternuts, and chestnuts are grown to great perfection. Peaches and apricots ripen in August, grapes and chestnuts in September and October, and olives in November in European Mediterranean lands, affording a succession of crops. Northern cereals are grown in the mild season, and rice, cotton, tobacco, maize, and flinty wheats in the hot summer. Early flowers, fruits, and vegetables are produced for the markets of cooler regions. Irrigation is often necessary, and in the most thickly populated agricultural districts, corn, vegetable, or forage crops like lupin and lucerne, are cultivated among the trees of the olive groves, thus rivalling the anemones and cyclamens seen among the wild evergreen oaks. The goat, sheep, pig, mule, and ass are the characteristic animals ; cattle are not numerous. Unfortunately, man has destroyed many of the forests, with the result that the water supply has been disturbed, and the hillsides reduced to barren rock.

No other vegetation has influenced more the history of mankind. It has acted as a pole of attraction ; developed artistic races ; and fostered by its easier conditions an earlier civilization than that of the temperate cyclonic regions.

The *eucalyptus forests* of south and east Australia, the *araucaria forests* of south Brazil, and the *quebracho forests* of the South American Chaco, are evergreen forests intermediate between the " Mediterranean " and the sub-tropical dry land types. Eucalyptus forests usually form a kind of park landscape, grassy glades intervening between the scattered trees. Often the trees are of great height (300 to 400 ft.). They are characterized by strong tap-roots which reach ground-water at great depths, patchy crowns and ragged bark, and drooping scythe-like leaves which hang edgewise to the sun, and thus afford no shade. Araucaria trees grow in low clumps, which are frequently crossed by swards of short grass or thick undergrowths of evergreen shrubs, such as the yerba maté. They have straight and slender trunks, short, hard, thick, needle-pointed leaves, and flat crowns of horizontal branches. Quebracho trees are noteworthy for their gnarled and twisted forms, and their tiny, inconspicuous, hard, finely-divided leaves. Valuable hard timber and useful gums are the chief economic products of these forests.

TEMPERATE SCRUBLANDS. These are found in parts of Australia and California, where drier conditions prevail than those of the "Mediterranean" belts, and where the grazing of animals, fire, and the axe of man prevent forest growth. The Australian scrub, dreary and dreaded, is monotonous in the extreme, relieved only at rare intervals by flowering shrubs. Under a fierce sun and a remarkably clear atmosphere, closely packed, dull-coloured, prickly, sticky, scented, evergreen shrubs with stiff, dry, simple, entire leaves often coated with wax and arranged obliquely to, or parallel with the light, make slow but continuous growth. The mallee-scrub in the half-arid interior of south and south-west Australia exists in a warm-temperate climate with a mean annual rainfall of at least 15 inches, and presents a boundless, waving sea of yellowish-brown eucalypti, six to ten feet high, growing in dense formation, with no grassy swards, and hardly any flowers on the bare rust-coloured soil. The brigalow scrub develops under hot tropical conditions with a mean annual rainfall above 15 inches. It consists of thorny, dwarf acacias with sickle-like leaves of a shimmering silver-grey colour, forming impenetrable thickets, avoided by animals and man; a few herbs bearing bright flowers occasionally relieve the monotonous landscape. The mulga scrub occupies drier lands (a mean annual rainfall under 10 inches), and displays a more open formation of thorny dwarf acacias and a ragged carpet of such dry grasses as the kangaroo, porcupine, and spinifex. On the foot-hills of the ranges in Arizona and New Mexico, and in north-west Mexico and lower California, the chaparral, consisting of impenetrable thickets of evergreen shrubs —dwarf oaks, mezquites, and leguminous plants—with leathery, prickly leaves and thorny bushes, is well developed. These scrublands are unfavourable to pasture and agriculture, and so remain uncultivated.

On the high plateaux of Asia Minor, in belts round the deserts of central Asia and Australia, in the Great Basin of North America and as far south as central Mexico, on the southern Kalahari plateau and parts of the Karroo, north of the Sahara and of Arabia, south of the Argentine pampas, and in Patagonia, where there are sharp contrasts of heat and cold, and where rain falls only in occasional short, heavy showers or in fine drizzles, the *sage brush* type of vegetation prevails. Vast undulating or flat expanses are covered with hoary or dull-grey, stunted, sticky, scented sage—or heath-like shrubby perennials, 3 to 6 ft. high, of besom-like appearance, growing sometimes densely, sometimes in scattered formation. Though usually neglected, these lands often have very fertile soils, and when irrigated and cultivated as in Utah by the Mormons, or "dry-farmed" as in Arizona, good crops of wheat, maize, and lucerne are obtained. Another useful product is rubber from the sage-like guayule of Mexico.

Temperate Grasslands. Grasslands of temperate type, consisting of steppe, prairie, pampa, and veld, occur where the environment comprises a severe and dry winter with two to four months of frosty weather; a mild and moist early summer with frequent showers; a hot and dry late summer and autumn with two months of excessive heat; a mean annual rainfall of 14 to 24 inches (rainy days seldom exceeding 100); a continuous dry atmosphere, especially in winter when strong, icy winds blow; and flat or rolling plains with soils of very fine loam, loess, clay, or sandy clay. They are usually found in the hearts of continents, and embrace the prairies and high plains of Canada and the United States, the pampas of Argentina, the South African high veld and parts of the Karroo, the Eurasian steppes between the northern Siberian forest and the central deserts from Manchuria and Korea to southern Russia, the Hungarian pusztas, and parts of Bulgaria, Rumania, Italy, and Spain. Tree growth is restricted to the meadows along the river courses and the neighbourhood of the dwellings of man, for the soil is often too loose to hold trees against the high winds, and too compact, dry and airless for trees to survive (a mean annual rainfall of at least 20 inches seems necessary for tree growth in cool temperate regions); the close mat of tiny and tangled rootlets of the grasses and herbs, which covers the soil with an impervious felt, deprives trees of air and water; seedling trees are prevented from developing by the incredibly rapid growth of the grasses in the spring; and, in the war between grass and trees, the former has sometimes been aided by the destruction of the latter by fire and the axe of man. In spring the bluish-green carpet of grass over boundless tracts is made resplendent with yellow, dark-red and white tulips, yellow and blue lilies, and the delicate rose-red or reddish-white woodbine.

The scorching sun of summer gives the grassland a brown, dry, lifeless aspect ; autumn sees a grey, yellow landscape ; and winter clothes it with a white mantle of snow. The changeful Argentine pampa has been thus described : " Coal black in spring when the old grass has been burned ; bright bluish-green when the young leaves sprout ; later on brownish-green, the colour of the mature grass ; finally—at the flowering time—when the silvery white spikes overtop the grass, over wide tracts it seems like a rolling, waving sea of liquid silver."

The grasses are tougher, drier, and harder than British meadow-grasses ; their leaves are narrow, rolled-in, and wire-like ; and they often grow in tufts. Among the different aspects are the wavy feather-grass, and close tall tufts of golden-beard grass of the Hungarian pusztas ; the silver-white, feather-grass carpets of the Black Sea region ; the separate dense tufts of stiff grasses of the Argentine pampas ; the sheep- and thyrsa-grasses of the Russian steppes ; and the prairie-, grama-, and dirty-green buffalo-grasses of the North American prairies.

The comparatively inaccessible grasslands, like those of central Asia, are sparsely populated by primitive races, leading a nomadic pastoral existence. Under more favourable conditions, such as those of North and South America, the " black-earth " (chernoziom) region of Russia, and the Hungarian pusztas, Europeans or peoples of European descent, have developed agriculture (sometimes by means of irrigation) and caused the retreat of the pastoral industry to the drier areas, and thus the better-watered grasslands are now among the world's chief granaries. From the steppes man has gained a sense of uniformity, the conception of the one-Shepherd God, and the ideal type of self-sacrifice.

Cool Temperate Broad-leaved Deciduous Forests. These occur at low altitudes in regions where the environment includes a cool-temperate, moist climate, with rain, largely cyclonic, at every season ; a continuous moist atmosphere and ground-water available throughout the year ; extremes of temperature between summer and winter (small near the sea and fairly marked in continental areas) ; a mean annual temperature of 46° to 54° F. ; a mean annual rainfall of 28 to 60 inches ; moderate winds of small desiccating power ; and varying types of soil. They are found, in patches or in continuous formation, in central and western Europe, north of the Alps and Pyrenees ; in Russia in a belt wedged between the northern coniferous forest and the southern steppes, dying out towards the Urals ; in Amuria, north China, and Japan ; on both sides of the Appalachians, westward beyond the Mississippi ; and northward to the Great Lakes ; in Patagonia, southern Chile, and Tierra del Fuego ; but are almost absent in Africa and Australia. Among the trees are the familiar oak, elm, walnut, ash, maple, chestnut, beech, poplar, sycamore, and aspen, broad-leaved with inconspicuous flowers and mesophytic in character ; and the broad thick-leaved tulip, magnolia, and camellia trees in the mild winter regions. Trees are social, and there is no great profusion of species. Tall, sombre beech forests shut out all competitors and exclude all undergrowth except a few mould-loving species, such as the lily of the valley, the primrose, and the anemone ; oak forests more open, lighter, and smaller, permit the ash, birch, maple, poplar, and elm to flourish in them, and an undergrowth of shrubs, herbs and grasses to exist ; tangled masses of willows, poplars, aspens, alders, and birches occupy the marshy ground ; sweet-chestnut forests grow on the granite and siliceous soils of south and east Europe ; and a thin woodland of hornbeam, elm, lime, and hazel characterizes the hilly limestone districts of central Europe. Slow tree growth, short stature, and the formation of great quantities of wood as reservoirs of plant food during the resting season, are all answers to the environmental conditions. Grasses of the succulent meadow type, non-fibrous, tall and profuse, flourish in the wetter, milder areas ; short, harder pastures under drier conditions. In places the contest between forest and meadow, tree and grass, is keen ; environmental conditions—humidity, altitude, and the nature of the soil—and man's intervention are the deciding factors. The Appalachian forests surpass in beauty, variety, and luxuriance those of Europe and west Asia. When the polar ice of past ages invaded the now temperate latitudes the vegetation of eastern North America and Asia was forced to the south. On the retreat of the ice, the new vegetation, which began to occupy the lands thus laid bare, was mostly recruited from the rich southern floras. In Europe and western Asia the earlier flora was destroyed, and the new plant population was mostly drawn from the east.

The vegetation of western Europe differs from that of central Europe in its park-like appearance of wood- and valley-meadows, its tender green foliage approaching evergreenness, its longer leafy stage, and, on its Atlantic fringe, in the luxuriant growth of native and imported evergreens, such as the holly, yew, cherry laurel, and Portugal laurel. It was the lush grass of the graceful wolds which attracted the eastern pastoral invaders from the sombre central European forests. The well-kept woodlands of Europe and America bear, to-day, little resemblance to the primeval wilderness of forest, strewn with mires and swamps, which made even the barbarians pause.

The soft-leaved temperate forests have been converted into grass and arable lands in many parts, and are now occupied largely by the highest civilized races, the keenest in agriculture, pastoralism, industry, trade, and commerce. Afforestation is becoming a necessity in Europe and North America ; for much timber has been wasted, much is needed, and temperate deciduous trees are slow to grow.

THE TAÏGA. This coniferous or needle-leaved forest, or sub-arctic forest, is a very widespread vegetation, extending almost uninterruptedly over the north of America and Eurasia. In Asia it reaches its southern limit at about 55° N. ; in north-west Europe at about 60° N. ; and in the east of North America at about 45° N. Forest trees cannot grow in regions where the average temperature of the warmest month is less than 50° F. ; nor where strong winds cause excessive transpiration during the period of physiological drought. In Alaska and the Mackenzie basin, the coniferous forest belt extends 300 miles north of the Arctic Circle ; in the east of Canada it ends 500 miles south of it, owing probably to the reduction of the summer temperature by the great frozen northern area. The northern limit rises again in Norway, but falls in the neighbourhood of the frozen White Sea.

The climate of the Taïga is decidedly cold and moist. The mean annual temperature ranges from 39° F. to 46° F. with possible extremes of $-58°$ F. to $+ 122°$ F.—extreme winter cold and very great summer heat. The rainfall is moderate but fairly regular throughout the year ; inland, however, towards the south, it becomes scanty. Soils are generally poor and of glacial origin, sandy, clayey, or pebbly. Light pine forests occupy the dry, sandy soils; dark and heavy spruce forests the moist and marshy ground; while larch forests occur on deep well-aerated soils. Northward, the forest grows stunted and scattered, and the trees, often of great age, are low and gnarled, with a high percentage of wood and strong rough bark. The trees are forced to live slowly, to make little demand on both soil and climate, and to store abundance of food in their tissues during the favourable season. Xerophytic pines, firs, and spruces spend little, earn little, and hoard much. Their short, evergreen, needle-shaped, thick, leathery leaves resist the cold, and enable them to breathe slowly; while their fibrous structure and conical shape make them stable even in strong winds. The larch, the chief tree of the more "continental" climates, is deciduous; and it is a curious fact that the deciduous birch in the northern, and beech in the southern hemisphere, are able to grow nearer the poles than the conifers. In the broad-leaved forest areas conifers grow on the dry, sandy soils and on the highlands. Strange to say, conifers—spruces, firs, douglasias—flourish along the wet western margin of British Columbia and the United States, where the conditions favour the broad-leaved trees. Perhaps the conifers established themselves in these regions under harsher climatic conditions, and left no room for broad-leaved forests. Many of these conifers, under the favourable climatic conditions, attain great size and age, as the Californian redwood and the douglas pine, which sometimes reach the height of 300 ft., almost rivalling the gigantic eucalypti of Australia. In the Southern Hemisphere the coniferous trees are less continuous and more archaic than in the Northern Hemisphere, as witness the curiously scattered distribution of the monkey-puzzle trees (Araucarias) in Chile, Brazil, New Zealand, and New Caledonia.

The Taïga is the chief source of useful soft timber. Lumbering, saw-milling, and wood-pulp manufacture are among the chief occupations of the scanty, settled population; while fishing and hunting for fur and feathers occupy nomadic Indians, half-breeds, Samoyads, Buriats, and Yakuts. On the southern edge, in clearings, the cultivation of hardy varieties of barley, oats, and rye is steadily increasing.

THE TUNDRA. North of the coniferous forest line on mainland and numerous islands stretch the Tundras of Eurasia and the barren lands of Canada—monotonous, flat or rolling plains, broken by rugged dykes, and dotted with lakes and swamps, bleak expanses of waste land with a scattered, stunted vegetation. The environment is severely hostile. Continuous night may last for several weeks; frost for eight months in the year; and vast regions lie buried under a mantle of snow for a longer period. Icy Arctic winds of great desiccating power prevail for many days. Water is precipitated mostly as hail, snow, or fog. Soils are unfavourable, the dry frost-bound Tundra being exposed to the full fury of the icy blast, and the moister ground may always remain frozen except for a thin surface crust. "There is the timberless waste where ice-laden blasts blow with hurricane and ceaseless fury that bid your blood stand still and your breath come and go in painful stinging gasps; where rock and lichen and moss replace soil and trees and herbage; and where death by starvation or freezing dogs the footsteps of the explorer. And everywhere silence; no sign of life, no vegetation, save the black moss that is used for fuel in summer by the Indians, and the grey moss and lichens upon which the musk-ox and caribou feed."—*Caspar Whitney*.

In the very brief summer, under continuous or almost continuous light, the surface of the Tundra thaws sufficiently to produce a more or less swampy plain on which grow ferns, mosses, lichens, dwarf birches, willows, and junipers, stunted berry-bearing bushes such as the cranberry and whortleberry, and a number of Arctic herbaceous flowering plants—monkshood, geranium, forget-me-not, Arctic poppy, and saxifrage—which lead a very active life for six weeks or two months, accumulating quantities of food in their protected underground parts, and bedecking the ground with blossoms of astonishingly brilliant colours. The stunted nature of the vegetation is due to the short period of active plant life, and also, probably, to the continuous illumination. Brilliancy of blossoms, leaves and stems is associated with the presence in the plant-body of certain substances protective against exposure, and with the duration of the long summer day. The thinly-scattered population of the Tundras—nomadic Eskimos, Indians, Lapps, and Samoyads—eke out a meagre existence by hunting and fishing for fur and feathers.

Harsher conditions of environment nearer the poles produce the *ice deserts*, perpetual sheets of ice and snow, practically devoid of life. They include the whole of Greenland, except the coastal fringes, many of the Arctic islands, and the Antarctic continent.

Mountain Associations. Most mountains have usually an abundant rainfall on their lower slopes, and hence are forested. High equatorial mountains exhibit dense equatorial forests on their lower slopes, and perpetual snow deserts on their summits. A complete series of vegetation may be found in ascending equatorial mountains. The dense equatorial forests change gradually to the temperate broad-leaved forests, and these are replaced by coniferous forests. At higher levels the trees become gradually dwarfed and shrubs and bushes become more abundant. Alpine meadows, gay in spring and early summer, with bright flowers and rich lush grasses, occur in the bottoms of the high valleys ; while above these shrubs and meadows there are the tundra regions just below the limits of eternal snow. On lofty, dry, cold plateaux, such as the punas of the Andes, and the Pamirs and Tibetan plateau of Asia, a tundra vegetation of scattered bushes and coarse grass tufts supports herds of yaks, wild asses, sheep, llama, alpaca, and vicuña. In the broad-leaved forest regions the mountains are clothed with coniferous forests up to the tree line, and highlands in the coniferous forest areas bear natural meadows and a tundra-like vegetation.

Nature fixes no boundary line between one type of vegetation and another, but each type merges gradually into the other—forest to savanna, savanna to scrubland, scrubland to desert.

Ocean Vegetation. The visible rays of the sun penetrate the ocean waters down to a depth of over 500 fathoms, but even the actinic rays do not penetrate as far as 900 fathoms. Down to a depth of 900 fathoms plant life may be possible, but at a greater depth than 200 fathoms, vegetation is extremely scanty. In the well-illuminated waters there are often found vast floating meadows of unicellular algae, which form the food material for fish-life. Beneath the zone of light assimilating plant life is not present.

(*b*) **ANIMAL LIFE.**—" Organisms must be complex and yet coherent, plastic, and yet durable."—*J. Arthur Thomson.*

Terrestrial plants by affording food, shelter, and moisture, enabled the animal life of the waters to make a complete conquest of the dry land. From seashore and freshwater, after a long apprenticeship, animals passed to the more strenuous struggle on the land, where they have adapted themselves to the differences between day and night, and summer and winter. All animals obtain their food either directly or indirectly from plants. To lion and lamb alike, life would be impossible in a world without plants. Accordingly, therefore, as the vegetation is rich or scanty, animals are many or few in number, and the distribution of animal life on the earth exhibits a general correspondence with that of plants. Animal plasticity permits the presence of animal life under the most varied conditions, and forms ever adapt themselves to newly arising conditions. The insurgent nature of animal life is most wonderful. The contrast provided by the few fur-bearing animals of the polar regions, and the varied almost bare-skinned animal life of the tropics, brings out clearly environmental control. It has been found that different life conditions make their imprints on animal life in certain definite ways, so that the habitats of animals can often be inferred from their general appearance, and especially from their protective and warning colours. The keen struggle for existence has resulted in many animals acquiring a garment of invisibility. A number of tundra birds and mammals, such as the ptarmigan, mountain hare, Hudson's Bay lemming, Arctic fox, and weasel, have light-brown coats in summer, which match the colour of the lichen-covered rocks ; while in the long winter nature adorns them with pure white suits, the fittest and most economical, for they harmonize with the snow, and conserve the warmth of the body which enables the chemical processes to go on quickly and evenly. Even when animals are in no sense weaklings, to be inconspicuous is an advantage when resting, pursuing their prey, or taking care of their young. Desert animals are generally duns or greys, such as the camel, gazelle, and lion ; and are thus practically indistinguishable from the sand and rocks. The colours of the larger animals of the savannas help to conceal them from their enemies, or from the prey which they seek. They hide in the tall grasses and leafy bushes during the wet season ; while their brown, tawny, or striped coats during the dry resting period match the prevailing colours of the bare rocks and scanty vegetation. The denizens of jungles are striped or spotted, like the tiger or zebra. They appear very conspicuous when seen in menageries, but their colour-bands simulate the bars of sunlight and the lights and shadows among the cane-brakes and tall jungle grasses of their habitat. Wonderfully harmonious are the dappled colourings of the forest-dwelling leopard, jaguar, fallow-deer, and boa, which render them indiscoverable amidst the alternating patches of light and shade caused by the pencils of light struggling through the interstices of the leaves. Forest insects are usually green, matching closely the chlorophyll of the leaves. In the evergreen tropical forests, green birds of many different and unrelated families abound. Warning coloration is seen in some animals, notably venomous lizards, conspicuously marked wasps, tropical caterpillars and skunks.

Localization of Animal Life. Many animals can adapt themselves to very varying temperature conditions, and, therefore, their range is chiefly restricted by natural barriers such as a stretch of desert, a snow-clad mountain range, a sea, or an ocean. Some animals, like the goat and chamois, are naturally confined to mountainous regions; some, like the beaver and hippopotamus, can exist only near water; some, like the giraffe and zebra, dwell only in open country; while some, like the lion, tiger, and elephant, can live equally well in open country or in forest regions. Great heat and great cold are overcome by insurgent animal life. Thus, animals exist among the snows of Monte Rosa at an altitude of 10,000 ft., insects in hot springs, and small fry under 15 ft. of Antarctic ice. Nansen found the Arctic ice teeming with thousands of millions of microscopical organisms. Man destroys natural vegetation, hunts big game, and introduces his domestic animals into regions formerly occupied by the wild; he thus tends to restrict the number of wild animals. In certain regions animal life shows periodic changes. The active life of many invertebrates ceases when the food supply fails during the resting period in the vegetable world. Some invertebrates, therefore, pass the resting season in the form of eggs or pupæ; others remain in a state of suspended animation. Animals, such as lizards and frogs, which feed on invertebrates, hibernate; while birds migrate to warmer, richer climes. There is never, however, an entire absence of food. Seeds, berries, nuts, fruits, and underground stems are to be found, and they provide subsistence for many birds and mammals, themselves the prey of larger animals. The distribution of animal life to-day is not wholly accounted for by present environment. Other directing influences have been the migration of animals in the past, and the changes in the distribution of land and water in past geological times, which probably explain the peculiar marsupial native fauna of Australasia and South America.

Distribution of Animal Life. Though sufficient observations have not yet been made to enable an exact division of the world into areas occupied by definite associations of animals to be accomplished, yet the marked peculiarities of the animal life in forests, grasslands, deserts, and mountains give a broad basis of study.

Animals of the Forests. The wealth of vegetation in the equatorial and monsoon rain forests has caused a rich development of bird, insect, and animal life. In the upper forest world, the roof garden, gorgeously coloured birds, butterflies, and other insects flit through the boughs; snakes coil round the branches; and apes and monkeys spring from tree to tree. Millions of birds and monkeys live and die without ever having the experience of touching the ground. In the lower forest, reptiles and insects are the commonest forms of life. Purely arboreal mammals are a special feature of the equatorial forests. Among them may be mentioned the sloths, marmosets, and flat-nosed monkeys of Brazil; the lemurs, dog-faced monkeys and apes of West Africa and the East Indies; and the tree kangaroos of New Guinea. The dark colour and rough skins of the crocodiles of tropical waters which cause them to resemble old logs; the striped snakes which match the shifting lights on the tree trunks; the brilliantly spotted butterflies which are difficult to see; and the green feathers of the birds which match the leaves, all show adaptation to environment. Luxuriance of tropical undergrowth crowds out the larger ground animals, only the elephant, with its vast bulk, being able to force a path through the virgin forest. Where the forest is more open, as in the hot monsoon regions and the lands of tropical summer rains, the number of ground-dwellers increases, and they have also many so-called "flying" animals, such as the flying squirrel, the flying shrew, and the flying phalanger. Among the larger carnivorous animals are the South American jaguar, the tiger, and the leopard; and other life types of the extensive list of tropical fauna are the tapirs of South America and Malaya; and the pythons, boas, and the great anaconda of the "selvas." Four species of anthropoid or man-like apes dwell in the tropical forests: the gorilla in the forests of West Africa, the chimpanzee in those of West and Central Africa, the gibbons of the mainland of south-east Asia, and the ourang-outang of Borneo and the adjacent islands. Gorgeous bird-life is seen in the glorious birds of paradise inhabiting the forests of New Guinea and neighbouring lands; the brilliantly-coloured macaws and humming birds of the South American forests; and the crested cockatoos of the north Australian forests. Useful types of animal life are largely absent; and the abundance of the varied life is its own chief enemy.

There are two broad groups of animals in the Taïga or coniferous forest: those which are structurally adapted for forest life, such as the squirrel, lynx, wood-pecker, and tree-frog; and those which roam over the prairies and steppes but visit the forest for shelter or food, such as the deer, wolf, and fox. The important animals belong either to the ungulates (hoofed animals), the rodents (gnawers), or the carnivores (flesh-eaters). Among the ungulates are the wild boar and many varieties of deer. The rodents include squirrels, beavers, rabbits, and Canadian porcupines. The carnivores are chiefly bears, lynxes, members of the weasel family, martens, gluttons, badgers, and wolverenes. Reptiles and amphibians are few, but insect life is rich. In the deciduous forests animal life is similar to that of the Taïga.

Animals of the Grass and Scrublands. The savanna is the home of the grass-eating mammals, the African savanna being specially characterized by its enormous wealth of ungulates. Antelopes, zebras, gazelles, and giraffes, graze on the pastures, and are preyed upon by lions, jackals, panthers, hyenas, and leopards. Crocodiles infest the rivers, and the hippopotamus and rhinoceros inhabit the marsh lands. Most savanna animals are swift and leap easily through the tall grasses; notable exceptions, however, are the bulky elephant and hippopotamus which have to trample their way. Like desert animals, those of the savanna can go for a long time without water, but they drink deeply when they reach it. The long neck and fore limbs of the giraffe, and the trunk of the elephant, enable them to browse upon the leaves of the acacia and other trees which rise above the grasses. In the scrublands the flightless, swift-footed, keen-sighted ostrich, rhea, emu, and cassowary are found, and rodents abound. The steppes of the Old World are the home of the domesticated horse, ox, sheep, buffalo, and camel; but both South and North America owe their vast flocks and herds to Old World introductions. The larger animals of the Temperate Zone, in order to secure food, move northwards or up the mountains in summer, southwards or down to the sheltered valleys in winter; in the tropics the movement is away from or towards the Equator with the swing of the rainfall belt, or towards the river valleys and permanent water-holes as the season changes from wet to dry. Owing to the advance of settlement over the temperate grasslands, and to a certain extent into the forest, the larger wild grassland and forest animals are becoming extinct; the bison of North America has almost disappeared, and the elk, moose, wolf, wild cat, and beaver are becoming rare.

ANIMALS OF THE HOT DESERTS. The scanty vegetation of the hot deserts supports only a few insects, rodents, reptiles, and birds. Desert animals conserve water by being non-perspiring. They need long legs, strong hearts, good wind, and keen senses to gain the capacity for rapid movement which is so essential in finding herbage in a new area, in getting out of a dry and parched land, and in fleeing from enemies when there is no possibility of concealment. No greens are seen among desert creatures, but they are generally sympathetically coloured—grey, brown, or red, harmonizing with the colour of the sand or rock. The gazelle shows double-colour adaptation. Its coat so closely resembles the general colouring of the landscape—white on sand, dark grey on volcanic rock—that viewed from afar, and when at rest, it is almost indistinguishable from the surrounding sand and stones. The two-humped Bactrian camel and the one-humped Arabian dromedary show wondrous adaptation to their environment. Their two toes with short nails, instead of hoofs, are almost embedded in a strongly developed expansible sole-pad with an elastic cushion between it and the bones. This gives a surface which expands under pressure, and is eminently suited for moving over the loose sand and rocks. The first division of the stomach has a water storage device by means of which water can be doled out when needed; the hump or humps serve as interior commissariat; the hard mouth and teeth are adapted to the coarse desert herbage ; the head, held horizontally, protects the eyes from reflected heat, and the eyes and nostrils from sand ; and long lashes for the eyes, ears covered with hairs, and closable nostrils are other adaptations. Temporary migrants desertward, during the periods of fertility, are the larger animals of the grass and scrub lands. In common with the desert nomads and their flocks they make a regular exodus when the waters dry up and the vegetation withers.

Animals of the Tundras. During the long winter months the frozen, moss-covered swamps are almost destitute of animal and bird life ; but in summer the pools and boggy places, formed when the surface thaws, become the breeding ground of innumerable insects, and flocks of migratory birds such as geese, eider ducks, cranes, loons, and swans, fly polewards to feed on them. The migratory, herbivorous reindeer—the " camel of the Arctic desert "—musk-ox, elk and caribou feed on the mosses and lichens ; while the carnivorous polar bear and arctic fox, well protected by thick fur and fat against the cold, wander over the ice-covered areas of the extreme north of the Tundras where vegetation is almost absent. Seals, walruses, penguins, and gulls feed on the fish of the polar seas. Stefansson says that the Canadian Arctic prairies have caribou in herds of tens of thousands, with lesser numbers of musk-oxen here and there ; and that there are many polar foxes, both white and blue, that feed in summer on the unbelievable swarms of lemmings that also form the food of thousands of owls and hawks and gulls. Nature's verdict in favour of beauty is shown in the adaptation of the winter and summer coats of the animals to their surroundings.

Animals of the Mountains. The special features of mountain fauna are the paucity of carnivores and the richness in ungulates. Sheep and goats, agile, small-footed, and specially protected against the cold, are the typical forms. Goats can thrive in drier and more barren regions than sheep, and in the wild state are found at higher altitudes. Peculiar to South America are the camel-like and sheep-like wild guanaco and vicuña, and the domesticated llama and alpaca.

There is beauty everywhere in the organic world, though marred sometimes by man's mistakes—the beauty of struggle and endeavour, of sifting and singling, of self-sacrifice and love.

Domestic Animals. The chief domestic animals whose products enter into commerce are cattle, sheep, pigs, goats, camels, reindeer, and horses.

CATTLE. Cattle are the pioneer animals of the grasslands, the forerunners of a settled population. Their size, strength, and speed enable them to combat dangers or to flee from them, and on account of their ability to withstand heat and moisture they are found in practically all regions except the Arctic tundras, and the tropical and monsoon rain forests. Two main types have been produced, which when well fed and placed in suitable environments, develop on different lines. The " dairy " type, adapted to " insular " climates and lush grass, includes the "milk" strain of Shorthorn, the Holstein, Ayrshire, and Jersey ; while the " beef " type, suited to drier conditions and coarser grass, comprises the Aberdeen-Angus, Hereford, and " beef " strain of Shorthorn.

SHEEP. Probably the original home of the sheep was the mountains of central Asia. To-day, British and other breeders have adapted some varieties to lowland conditions, and sheep roam in all lands, except the most torrid, cold, and humid. As typical montane fauna sheep are suited to rough pastures and are excellent travellers ; but being weak, stupid, defenceless, and prone to disease, they need constant care. For wool-making purposes, a dry, temperate climate tending to warmth, such as the " Mediterranean " type, is required. The merino is pre-eminently the " wool " sheep. It was introduced as a black sheep into Spain from Africa by the Moors, and from it Spanish breeders developed the valuable white-woolled merino, which was the progenitor of all the different merino strains now recognized by distinctive names and characteristics—the French " Rambouillet," the German " Saxony," the Austrian " Negretti," the North American " Vermont," the Cape merino, and the Australian merino. Mutton is the product of " insular " climates, and among the best " mutton " sheep are the Lincoln, Leicester, and Southdown. Recently, successful attempts have been made in Australasia and Argentina to breed a " cross-breed " type, which yields fair mutton and wool.

GOATS. Goats are associated with sheep throughout the world, but can survive under harsher conditions. They are important in all semi-arid lands as wool-producers, and thrive on the coarse and scattered grass of high altitudes. The Angora goat, said to have been raised by the Turks for over 2,000 years in the vilayet of Angora, in Asia Minor, is the most noted. It has been introduced into South Africa, semi-arid Australia, and semi-arid America. Well-bred Angoras produce silky-white and exceedingly lustrous mohair, ten inches in length.

Pigs. Pigs were, originally, forest animals, feeding upon acorns, nuts, roots, and other highly nutritious foods, and they have easily adapted themselves to the rich grains of the farm. They have attained almost world-wide distribution, largely because of their hardiness and fecundity. As meat animals of grain-growing lands they are highly profitable to the dairy farmer and cottager. Breeders have produced two general classes—the " bacon " type, represented by the Yorkshire and Tamworth breeds, and the " lard " type, ideally found in the Poland-China.

Horses. Horses are the aristocrats of draught animals and the most important animals of steppe nomads. They have a wide range, being found everywhere except in forest, tundra, and fly-infested regions; but, in practice, they are largely confined to Caucasian races. Zoologists recognize four types, from which have developed the modern thoroughbred, the product of English racing; the heavy draught of western Europe, represented by the Shire, Clydesdale, Suffolk, and Percheron; and the driving horse, illustrated by the hackney and trotter. Ponies are small types of horses, and are probably the result of an unfavourable environment, especially food supply. Mules and asses, hardy, long-lived, and able to thrive on scanty pastures, have become the draught animals of semi-arid and " Mediterranean " lands. From Morocco to Pekin, in the mountain regions from Alaska to Patagonia, and in the American cotton states, they thread the mountain passes, draw loads of logs, or pull the cotton cultivators.

Oxen. In nearly all cattle-rearing countries oxen are used for draught purposes. They draw carts over the muddy sugar-cane plantations and swampy fields of Central America, logs in the American lumber camps, and Boer wagons in South Africa. Millions of people in India utilize them in primitive farming operations, and the water-buffaloes of south-east Asia are the chief beasts of burden in that region.

Hot deserts and oases are the natural home of the *camel*, which has been trained to carry heavy packs across the desert wastes. The *elephant* is a dweller in the humid tropical forests of Asia and Africa, which supply him with sufficient fodder to satisfy his enormous appetite. Docile and easily trained, he is most useful in lumber yards, and his domestication in Africa may help to solve the transport problem.

Reindeer are the draught, meat, and milk animals of Eurasian tundra nomads; while the *dog*, like man, capable of living in all types of climate, draws the sleigh of the Aleut and the Eskimo, the fur trader, and the gold prospector, and the milk cart of the small farmer of western Europe. On the high plateaux of central Asia the *shaggy yak*, close cousin to the ox, uses the long thick hair on the under part of his body as a natural mattress when lying on the deep snows, and by his aid trade is carried on between isolated Tibet and India. In Peru and Bolivia, the *llama* lives on the coarse tufted "ichu" grass, and carries burdens of seventy-five to one hundred pounds over the steep Andean defiles.

CHAPTER IV

THE LEADING NATURAL INDUSTRIES

> "As civilization develops social institutions are moulded more by the products of human thought and less by impressions of Nature. Ideas play a greater rôle, climate and scene a lesser rôle."—*E. A. Ross.*

THE industries of man are controlled partly by his environment, partly by his character; and, conversely, man's occupations profoundly modify and develop his habits, customs, and ideas. Food is the first need of man, and its amount and accessibility primarily determined his distribution. Increasing wants with advancing civilization brought into prominence the factors connected with clothing, health, recreation, pleasure, and religion. Highly civilized societies have generally (though not necessarily) passed through the pastoral and agricultural stages in their progress to the modern industrial and commercial stage.

Primitive man occupied in the mere gathering of wild vegetable products, nature's gifts, illustrates the simplest, almost thoughtless, way of gaining a livelihood. Progress is made when man becomes a hunter and fisher, for intelligence and skill are then demanded. A further advance is shown when by forethought, care and co-operation, man is enabled to domesticate animals. Agriculture, the basic industry, attaches man to the soil and the silent bosom of the earth, from which arise currents of life and energy. It demands settled conditions; encourages the arts and crafts; causes the birth and growth of cities; and helps to develop the mining, manufacturing, and commercial functions of society.

GATHERING OF VEGETABLE FOOD.—The gathering of fruits, nuts, berries, and roots is the most primitive occupation. Few races, however, get their living entirely in this way; many engage also in hunting and fishing. The peoples, who are mainly gatherers, are the Pygmies and other tribes of the dense Congo forests and the Indians of the Brazilian selvas, who are ignorant of the art of clearing forests and growing plants; and the Fuegians of South America, the bushmen of the Kalahari desert, and the aborigines of Australia, who do not know how to keep flocks and herds or how to grow crops in the desert oases. Weak, backward, uncivilized, lacking the stimulus to mental growth, with little or no knowledge of art and without hope of a future life, these rude tribes are disappearing before the advance of civilization.

HUNTING.—In early times hunting was an important industry, often forming the means of livelihood of whole nations and tribes; but now the industry is confined to the tundras, the poorer grass and scrub lands, and the forests. Grounds rich in game are easily exhausted by a hunting community, which is, therefore, driven with irresistible pressure to a precarious nomadic existence. Hardihood, strength, swiftness, and endurance characterize the men, and to the women are assigned the carrying of burdens, the preparation of food, and the making of clothes and tents. The need of ranging over a large tract of land brings tribe into collision with tribe, and fights result; while the irregular food supply and the spectre of famine in winter often compel hunting peoples to leave their lands, and attack and plunder the settled, richer, and more peaceful peoples living in neighbouring fertile regions.

Furs. Hunting, in highly civilized countries, is usually a form of recreation, and is regulated and protected by law. It is in the forests of high latitudes, where the furred animals are hunted by the natives and by races more advanced, that hunting is important. Trading stations are established at convenient centres, and a regular traffic is arranged by means of which furs are sent from northern Russia, Siberia, Alaska, and Canada, in exchange for clothing, weapons, and tobacco. London, Leipzig, Nijni-Novgorod, Irbit, Yakutsk, Nikolaevsk, and New York are the great fur markets of the world. The best furs, such as those of the marten, fox, ermine, sable, musk-rat, mink, otter, beaver, skunk, and squirrel, are obtained mainly from northern countries, where the severer the winter, the better is the fur produced. South America supplies chinchilla, opossum and nutria skins; the Commander and Pribilov Islands in the North Pacific are noted for seal skins; east Canada and east Siberia produce the most valuable sables; and Australia is renowned for its rabbit, opossum, wallaby, and kangaroo furs. Lions, leopards, tigers, and monkeys are hunted in the tropical regions of Asia and Africa for their pelts which are used for rugs; and the African elephant is sought for its ivory tusks. To meet the growing demand for valuable skins, fur farms have been established in all the provinces of Canada, and the fur farmer has improved the fur of his domesticated fox so considerably that the trapper can hardly compete with him.

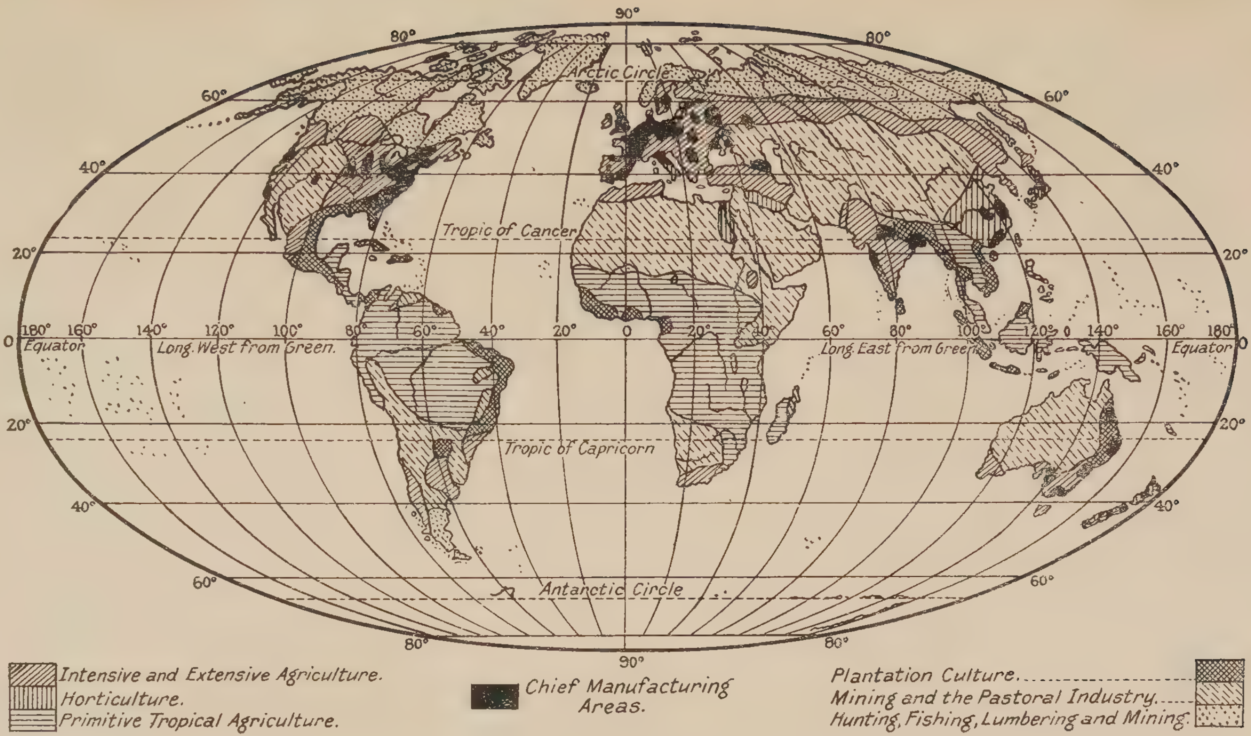
FISHING.—Fish is a valuable food, and, therefore, fishing is carried on by all races, from the most primitive to the most advanced. Few races are exclusively fishers, but are usually gatherers, hunters, and farmers, in addition. The Eskimo tribes are, however, exceptional, for the almost complete absence of vegetation and land animals forces them to satisfy their chief needs from the products of river and sea. Backward equatorial races living near the streams are also largely dependent on fish.

Among highly civilized races fishing is an organized industry. From various centres the fishing fleets go out to the fishing grounds, both near and distant, whence fast steamers convey the fish to the ports, and fast railways transport them to the populous industrial towns. The great fisheries are in the cool shallow seas above the continental shelf, especially where waters of different characters mingle, and fish food is plentiful; thus herring and cod are caught in the greatest numbers off the coasts of western Europe and north-east North America.

Fishing races are compelled to be strong and adventurous, democratic and freedom-loving. They have been the discoverers, traders, and colonizers of the world; and, possibly, by their efforts, the brotherhood of man will become eventually a reality.

PASTURING.—(*a*) **The Primitive Pastoral Industry.** The transition from the hunting to the pastoral stage marks a great advance in the history of mankind, for life was made less precarious, and self-sacrifice and preservation of life became ideals of this occupation. From the pastoral regions of Palestine came those conceptions of pastoral ethics expressed in the phrases, "The Lamb of God" and "The Good Shepherd."

The pastoral industry began with the first domesticated herd of cattle or horses, and the first tamed flock of goats or sheep, and, in its primitive stages, presumes a wide world of grass-covered land, and the absence of all other means of subsistence. From the era of Abraham, the Hebrew patriarch, to the present time, illustrated by the cattle kings and shepherds of the Argentine and Australia,



OCCUPATIONS OF MANKIND

one and the same figure, though under various disguises, eternally reappears in the pastoral life. There is but one picture of the primitive pastoralist travelling with his flocks and herds, his patriarchal family, and his moving tent. His physical necessities are satisfied by the products of his animals, and he becomes the parasite of grassland animals, a nomad with a migratory farm. He can defend his animals against the beasts of prey, and sometimes aid them in the choice of pastures ; but, generally, his chief work is to follow the habitual instinctive migrations of his flocks and herds, and derive from them his clothing, food, and shelter.

Care, skill, and forethought are necessary characteristics of the true pastoralist, and, for success, the constant co-operation of many people is demanded, which leads to a closely-knit tribal organization, whose institutions are very simple. A small compact group of actual relations lives as a single " patriarchal family," which consists of a father in whom power is vested, some mothers, children, and animals. Essential functions of the social group are the maintenance and reproduction of the domesticated animals, and the rearing of children. Every aspect of the pastoralist's life bears the stamp of mobility ; he tolerates no clog upon his movements. Furniture, implements, and weapons are reduced to a minimum, and are capable of easy replacement. His tent and clothes are of leather or felt ; a knife, a scraper for hides, a spindle and distaff, and leathern buckets and bottles of the dairy are his tools ; and his weapons consist of an ox-goad, a sling and a lasso—all simple, commodious, and easily replaceable. The form of wealth which he desires is that which transports itself—his flocks and herds—and that which is strictly portable—silver, gold, and jewels.

The pastoral age is the great watershed of religions and the main fount of spiritual power. On this side, and on that, it has poured down the faiths of Chaldaea, Palestine, Arabia, and ancient India, and on all it has left its stamp. The still, cooling waters and shady trees in the thirsty land became to pastoral tribes the messengers of God. Gloomy valleys and dark caverns spoke to them of the Divine awe, while the refreshing waters impressed upon them the Divine goodness. Gradually by environment, revelation, and inborn genius, the pastoral Jews conceived clear ideas of the one Creator, a shepherd God. Suffering always from its narrow local base, the monotheistic religion of the grassland Jew, characterized by its law of revenge, has remained a distinct tribal religion suited to an arrested economic and social development ; whereas, Christianity, an evolutionary growth from Judaism, widening with the world horizon, ever unfolding new wonders, and with Divine love as its motive force, is fitted for world-wide sway, and the enabling of man to fulfil on earth his best destiny.

Environment determines the nomadic life of the steppe and savanna pastoralist. The scope and rate of his wanderings are fixed by the distribution of pasture and water, which depends upon geographic conditions, and varies with the season. In Turkestan, the shepherds follow the rainfall ; the Mongols in Mongolia gather in groups in the sheltered valleys in winter, but disperse in summer, utilizing every water-hole and grassy patch ; while the Bedouins of arid Arabia pasture their flocks in the desert in the rainy season, and migrate to Irak in the drought. The necessity of guarding their pastures involves a permanent military organization among pastoral tribes. Economically, the pastoral nomads are herdsmen and shepherds ; politically, they have often been conquerors ; and, as ready fighters, they have largely affected the history of the world. Their self-supporting commissariat of flocks and herds; their constant practice of riding, scouting, and the use of arms ; and their physical endurance tested by ages of exertion and hardships, have made them formidable foes. Gathered in force under some great leader, such as Attila, or impelled by drought or famine, nomadic hordes have frequently conquered the settled, peaceful, and less courageous agricultural communities of Europe, Iran, India, and China.

Restless, rootless nomads, eternal children of the world, still range to-day on the steppes of central Asia, over the vast tracts that lie between the Altaic and Tauric ranges, and from the Caspian Sea to the Pacific Ocean, exhibiting those traits of character typical of pastoralists, denoted by the terms—hospitality, independence, unworldliness, endurance, resistance to natural forces and great calamities, self-help, courage, revenge, pride of race, keen powers of observation, fanaticism, and love of freedom. Often surrounded for leagues by immense flocks and herds, numbering from 10,000 to 100,000, their life is, nevertheless, precarious ; pests, variations of climate, and failure of wells may bring them to the verge of starvation, and the problem of winter food for man and beast is difficult to solve, even when aided by primitive agriculture on the oases. Living on meal cooked in sour milk to which, on occasions, bread and meat are added, making their clothes and tents out of the skins and hair of their animals, and carving bows and arrows from the canes that grow by the river beds, the warrior nomads continue their precarious existence. Government, properly speaking, they have none, but the taming and pasturing of wild animals have given rise to a permanent distinction of ranks, such as could never have arisen in the hunting stage of mankind. Greater industry or better fortune in the past enabled individuals to acquire more numerous flocks and herds, live in greater affluence, maintain a number of servants and retainers, and increase their power and dignity; all of which advantages were transmitted by these patriarchs from one generation to another. The tribes remain nomadic as long as they keep to the north of the fortieth parallel. Once they cross that viewless boundary, they instantly settle on the moister magical plains, build houses, form governments, wage wars, and fashion peoples. Nomadic life, to-day, tends to weaken into the settled life of the farm, the village, and the town.

Lower in the pastoral scale than the nomads of Asia are the Hottentots of South Africa, the Masai and Bahima of central Africa, and the Todas of India. European immigrants founded the true pastoral industries of America and Australasia. In North America the caribou and buffalo were not domesticated by the natives; and stock-raising in South America, dependent on the domesticated llama and alpaca of the Inca Empire, whose habitats are restricted to Andean altitudes of 10,000 to 14,000 ft., was merely an adjunct to the sedentary agriculture of the high intermontane valleys, and never became the basis of pastoral nomadism on the grassy plains. Even on the vast Argentine pampas primitive man found no herds of large animals capable of yielding a constant and valuable meat supply. Australia, isolated and monotonous, with strange forms of animal and plant life, awaited for centuries the proof of its adaptability for pastoral conditions. As homes for progressive pastoral peoples, both continents languished till the coming of Europeans equipped with resources which the natives could not wield.

(*b*) **The Modern Animal Industries.** The modern breeder has to study the environment to find out what amount of food and shelter his stock requires, and which types are suited to the physical conditions prevailing. Man rears animals on the grand scale for meat, clothing, and transport purposes. Meat is not a necessity, but man in temperate lands prefers animal food with vegetable products rather than the purely vegetable. So great has been the modern demand for meat that prices have greatly risen, and many experts believe that the future supply will have difficulty in coping with the demand. It is calculated that it takes five to ten pounds of grain to make a pound of meat.

In the early utilization of the pastoral lands of Australia and Argentina, meat was of little value, and animals were reared chiefly for the non-perishable and easily transportable hides, tallow, bones, and wool. Later, a growing local and foreign demand for meat gave rise to the " saladero " (salt meat) industry and the preservation of choice morsels of meat. The rapid increase of population in north-west Europe, unaccompanied by similar increase in live-stock, created a huge demand for meat from outside sources, which originated the frozen and chilled meat trade of America and Australasia. This has led to the fuller occupancy of the grasslands, the development of mixed farming, the increase of ranches or " estancias," a decrease in their size, and improved means of transport.

Nowadays, meat is preserved by sun-drying it, salting it, lowering its temperature, and raising it to a high temperature for a short time before sealing it up in air-tight tins. In each case the life of the minute germs which cause putrefaction is prevented. The modern " frigorificos," or freezing establishments, are well organized, often under American superintendence. Cattle and sheep are shipped in trainload lots to the stockyards, where they undergo veterinary inspection. When passed, they are driven into narrow enclosures, called " knocking pens," and pole-axed. The carcasses are conveyed on trucks to a shed, where they are hung up, bled, disembowelled, and skinned. Tests are made of the soundness of the meat, and, in a wonderfully short time, every particle of the animal is utilized. Bones are used for knife handles, buttons, and fertilizers ; hoofs for gelatine and glue ; intestines for sausage casings; and grease for soap. The major portion of the carcasses, if intended for the chilled beef trade, is placed in chilling chambers, kept at 29° to 34° F. for twenty-four hours, and then each carcase is cut into two and wrapped in a cloth. Frozen beef and mutton are treated in the same way, except that the freezing chambers are kept at about 15° to 18° F. In the refrigerating chambers of modern ships the requisite temperature is obtained either by the expansion of compressed air or by the use of brine, chilled by the evaporation of liquid carbonic acid and ammonia; or by the vaporization and circulation of formaline. "Tasajo" or "jerked" beef, a sun-dried and salted product, utilizes the inferior cattle of the South American republics, and finds an excellent market in Cuba, Porto Rico, and Brazil.

Modern stock-raising is scientific, and depends largely on transport facilities for food for the living animal, and to markets for the dead. It is intimately connected with agriculture, for stock are fattened, especially in "old" lands, on root-crops, oil cake, and corn. Ranching on a large scale is still possible in the sparsely peopled lands of the Southern Hemisphere, and western North America; but, even here, agriculture is driving pastoralism to regions unsuitable for farming. Daily, the life of the cowboy becomes less picturesque; rapidly, he is disappearing; and ranches with high-bred flocks and herds, and refined methods in order and management, are becoming numerous in Australasia and America. The growth of alfalfa or lucerne, the best existing fodder plant, is extending ranching in semi-arid lands. Its roots, on which are found the nodules containing nitrate-forming bacteria, penetrate to a great depth, and enable it to live in periods of severe drought.

In the cool temperate lands of the Northern Hemisphere, land and labour are dear, and animals have to be sheltered and stall-fed. These conditions are largely absent in the Southern Hemisphere; but the northern stock-rearers wage successful competition by employing more highly-skilled labour, by their nearer markets, and by mixed intensive farming. Dairying, now mainly associated with densely populated lands enjoying rich soils and cool temperate climates, implies very intensive agriculture, and the Danes have shown that it is one of the best methods of keeping population on the land.

The problem of the future supply of meat may be met by the lessened per capita consumption in pastoral and manufacturing lands; the synthetic production of meat; the possible future increase in the size of domestic animals; the keeping of larger flocks and herds on the same amount of land; and the opening of new sources of supply in Brazil, Venezuela, Mexico, Colombia, South Africa, Madagascar, and the vast Asiatic plains.

AGRICULTURE.—The Development of Agriculture. It is not known how, when, and where agriculture first began; but it was fairly advanced before Europe had passed out of the Stone Age; and great agricultural civilizations were flourishing in the valleys of the Nile, Euphrates-Tigris, Ganges, and Hwang-Ho several thousand years ago.

Among hunting tribes living in forest clearings, the women, who are often left behind when the men are away on hunting expeditions, frequently grow plants to make up for failure in the hunting. As game becomes scarce and the hunting grounds are reduced in area, more attention is paid to agriculture; and, eventually, the nomadic tribes become attached to the soil, make permanent homes, acquire property, and practise various arts and industries. The various stages in the development of agriculture are exhibited in different parts of the world to-day. In the Amazon valley, manioc shoots are placed in the river alluvium, and the Indians leave them untended till the large roots, from which the cassava "flour" is obtained, have developed. Many African tribes are farmers, as well as hunters and gatherers. They grow bananas, millets, and other cereals, yams and sweet potatoes. Maize, grown from an early period in equatorial and tropical America, has spread very widely both in the Old and the New World. In the East Indies, bananas, yams and sweet potatoes, together with the sago-palm and rice, are widely cultivated; and the coco-nut palm is the chief agricultural product of the Pacific islands. Powerful and wealthy agricultural communities are found in the Sudan, India, and China. They produce their own food and raw materials, and trade in luxuries and manufactures. The highest stage in agriculture is seen in the coal-producing and manufacturing countries of western Europe and the eastern United States, where farming is intensive and highly scientific. These old countries depend on new countries with abundant virgin soil for a large part of their food and raw materials, and export mainly manufactured goods.

The development of agriculture in the virgin countries of the temperate regions has usually followed one order. At first, the country is pastoral; but the opening of railways brings wheat or maize production. When closer settlement is made other crops are raised, and wheat loses its premier position; oats and green crops are needed for the animals; and the population that follows the simple-living pioneer has new agricultural wants. As transport becomes easier, fruit and vegetables are raised for shipment to the cities or for export. South Africa, Australia, Canada, and the United States show all of these stages of development. Finally, accumulated wealth brings leisure and freedom from the struggle for a livelihood, and there arises a fastidious people that picks and chooses and puts a price on subtle differences in the quality of land, inappreciable to the unsophisticated.

Land is a potent and conspicuous factor in the history of society. It enters into every necessity of life from the cradle to the grave. The organization and size of a social group, the character of its pursuits, and the aim, scope, and limit of its activities are powerfully influenced by the extent and nature of its habitat. Migratory hunting and fishing tribes, relying almost exclusively upon what the land or bordering sea produces, need a large area, and derive from it only an irregular food supply, which, in winter, may diminish to the verge of famine. In such a type of society, division of labour except as between the sexes, concentration of population, and evolution of classes are impossible. The transition to the pastoral stage results in a marked reduction in the per capita amount of land necessary to yield an adequate and stable food supply, and in a closer social bond. Further progress to the agricultural stage, especially when advanced to the intensive type, brings about the still more close integration of the social units, and an exceedingly great reduction in the per capita amount of land required to support life, for a skilful farmer on fertile land can subsist on a few acres. Civilized states, representing the highest social types, owe their superiority to the highly organized utilization of their whole geographic resources by their members, and to the development of enlightened governments, which are the consequence of increasing population, and the multiplicities of wants and activities resulting therefrom. Sedentary agriculture is their initial economic basis, and this is followed by industrialism and wide commerce. The pressure of population slowly unfolds the capabilities of every foot of soil, and of every geographic advantage, and inevitably tends in the long run to territorial extension. A noticeable feature in economic history is that the power to hold land is measured by the power to use it. Under-population threatens a retardation of development, and modern states with a low density of population per square mile when considered in the light of their geographic advantages are more vulnerable than those of like population more closely distributed. Change in areal relation, both of the individual to his decreasing quota of land, and of the state to its increasing quota of the earth's surface, may be taken as an important index of social and political evolution.

The Early Agricultural Civilizations. The first dawnings of civilization were in regions where life could easily be sustained, but yet where provision for the future was demanded. Such conditions existed in ancient Egypt. A long oasis, a narrow ribbon of exceptionally fertile soil annually flooded by equatorial and Abyssinian waters, provided an easy and ample means of livelihood ; a genial and beneficent climate, free from enervating heat and the rigours of great cold, encouraged advancement ; the insulated flanking hills and deserts helped to keep the land free from outside disturbances ; and the seasonal variations of flood and drought necessitated thought and foresight. Thousands of years before the birth of the Jewish Messiah, agriculture was practised in the Nile valley. Probably the earliest settlers in the valley obtained their means of subsistence by keeping goats and cattle, by hunting the deer, antelope and hippopotamus, and by fishing in the river ; and then superior pastoral tribes, with some knowledge of agriculture, coming from other regions, either from the south or east, displaced the original pastoralists, and practised anew with ease and great reward their agricultural arts. Adequately protected and isolated, Egyptian civilization developed without outside interference, but by virtue of Egypt's position and the river route, close contact with the world at large was attained. Gradually the arts and crafts developed ; the land became the granary of the world ; trade grew ;

government became a reality; the conception of a future life was gained; and vast buildings—tombs and temples—were reared, testifying to man's immortality.

Another early agricultural civilization was that in the land of the two rivers—Babylonia or the flood plain of the Euphrates and Tigris. Here, civilization required a longer period to grow than in the land of the one river, the Gift of the Nile. The rivers did not regularly and annually flood their banks as did the Nile; drainage was more difficult; and protection was less complete than in the Nile valley, for invasion could come from the nomads of the steppe on the west or the highland peoples on the north and east. The basis of the Babylonian culture was the intense fertility of the alluvial soil which required only water to "rejoice and blossom as the rose." A network of irrigation canals, the work of many generations, changed swamp into cornland, and desert into orchard. Other old agricultural civilizations were those based on the great river valleys of the Ganges in India, and the Yangtse-Kiang and Hwang-Ho in China, which, on account of their isolation, were largely out of touch with other lands; whereas the Egyptian and Babylonian culture spread throughout southern and western Europe.

Modern Agriculture. Agriculture has become highly scientific and intensive in the old developed countries of the world. The growth of population has greatly increased the value of land, and has compelled the modern farmer to study the soil, the heat and moisture requisites of each cultivated plant, the rotation of crops, and the art of manuring.

Physically, soils differ from one another in the condition of their particles. They may be coarse or fine, porous, or compact and tenacious. The greater part of the water that falls as rain passes into the soil, and is held by the soil particles against the force of gravity. It is known as capillary water, and though it cannot be seen as liquid water, its presence may be recognized by its effects upon the colour of the soil. If the water is in too great a quantity to be dispersed by capillarity, the rain-water runs down into the lower soil, and finally joins the ground-water, raising its level temporarily. When the weather is dry, the capillary water evaporates from the surface of the soil, and the soil then draws more water from below, but not in sufficient quantity to replace wholly that lost by evaporation, and, therefore, the capillary water decreases until another rainfall occurs. It is from capillary water that agricultural plants, for the most part, obtain the water containing the dissolved food constituents necessary for their growth. In order that they may make their best development, the soil must be in such physical condition that the roots of plants can readily penetrate it and ramify through it; it must contain sufficient capillary water to supply the needs of the plants; and this water must be renewed as it is taken up. It is quite possible for a soil to be physiologically dry, and yet contain more moisture than another soil, which supplies water to plants. Large air-spaces in the soil should be absent, as these cause the soil to dry out readily and prevent the development of the many fine branching rootlets necessary for the best development of plants. Good soils are porous but not loose, firm but not hard nor consolidated, close-grained but not run together nor adhesive. Humus, or decaying vegetable matter, is one of the most important constituents of all fertile soils. Though not in itself a direct form of plant nourishment, humus is the natural storehouse and conservator of nitrogen, and it increases the power of the soil to absorb and retain moisture. Where humus is abundant in the soil, it is associated with a liberal supply of nitrogen, and it has been noticed that the amount of humus present gives an excellent indication of the quantity of organic nitrogen which the soil contains. Humus furnishes the food upon which the micro-organisms in the soil live, and these convert the organic nitrogen of the soil into nitrates, the compounds which supply plants with the nitrogen essential to their growth. Typical humus soils are the "black soils" of the North American prairies. The object of the scientific farmer's tillage is to form a deep, mellow, but firm seed and root bed to absorb and store the rainfall and to prepare plant food, and to prevent the loss of water by evaporation as far as possible.

Soils in which clay predominates are very retentive of moisture, and are, therefore, generally an advantage in a hot, dry climate, and a disadvantage in a cold, wet climate. Sandy soils are the reverse, becoming desert in a hot, dry climate. Examples of highly fertile soils are the fine deltaic soils of the Nile, Ganges, and

Hwang-Ho; the "black earth" of south Russia; the black soils of the Deccan; the yellow loess of north China; the volcanic soils of Japan, Java, Sicily, and the north-west United States; and the vegetable mould soils of many forest "clearings." Among infertile soils are the laterites of tropical and sub-tropical lands, and the alkali soils of western North America.

Rotation of Crops. Sooner or later soils must lose their fertility, unless means are taken to prevent their deterioration. The plant-food of a crop is removed when that crop is carried away, and as the same kind of plant always requires the same kind of food, the fertility of the soil is generally reduced very rapidly when the same crop is grown repeatedly on the same land. Rotation of crops and manuring are the plans adopted to retain soil-fertility. The alternation of different crops on different areas, in place of growing one single crop-species on the same land year after year, spares the land. Different crops take different constituents from the land, and some of these crops may add to the soil an essential constituent for a succeeding crop. It is found that the residues of roots, stubble, and leaves, left in and on a field by the growth of a particular crop, prove excellent plant-food for another crop of a different species. When a crop of red clover is removed from the land, wheat following it thrives vigorously upon the decaying roots, rich in nitrates formed by the bacteria inhabiting them. Rotations utilize both horse and manual labour more fully and economically; simplify the preparation of the land; and render crops less liable to the attacks made by injurious insects. One of the most famous English rotations is the Norfolk four-course rotation—turnips or swedes, barley, clover, wheat.

Manuring. Manures are applied in order to provide crops with food in a form in which it is not naturally present in sufficient quantity in the soil. All farm crops require to have access to ten elements of food: carbon, oxygen, hydrogen, sulphur, magnesium, iron, calcium, nitrogen, phosphorus, and potassium. Of these, only the last three usually need to be supplied as manure. It must be noted that the yield of a crop depends upon the available supply of that essential element of plant-food that is present in least amount. No superabundance of plant-food generally can compensate for deficiency in an essential element; and so the scientific farmer applies, when necessary, nitrate of soda, sulphate of ammonia, calcium cyanamide, and farmyard manure.

Irrigation. Irrigation is the artificial application of water to ensure crop production, the water being conveyed to the land in specially constructed channels or trenches from a river, lake, or artesian well. To handle water on a given field, so that it shall be applied at the right time in the right amount, without injuring the crop, requires an intimate acquaintance with the conditions, good judgment, close observation, skilful manipulation, and patience after the field has been put into excellent shape. A close study of the agricultural conditions, under which artificial watering is being practised throughout the world to-day, reveals the fact that irrigation is not confined to those countries where the rainfall is so scanty that nothing will grow. On the contrary, in many countries where irrigation has been brought to the highest state of perfection, the natural rainfall is very heavy. Indeed, there must always be contiguous territory of considerable precipitation in order to produce springs and streams, from which water may be diverted for irrigation purposes. Where irrigation water can be applied economically to lands, it has some important advantages in crop production over the natural rainfall, even when that is large. In the first place, irrigation water can be supplied at such times and in such quantities as it is needed, and this gives a certainty to results, which is impossible where the outcome must depend upon the chance of adequate or inadequate, timely or untimely, rainfall. Secondly, water used for irrigation contains, almost without exception, larger percentages of both the organic and ash ingredients of plant-food than rain-water, and as this is largely in the soluble form, it becomes at once available and thus stimulates growth. Water from artesian wells fertilizes arid soils in Australia and Algeria; barrages, dams, and canals provide perennial irrigation in Egypt and the fruit-growing regions of Australia; and millions of acres in the United States have become crop-producing by systematic irrigation.

Dry Farming. This term implies the preservation of moisture in the soil by covering it with a layer of material. It has partially solved the problem of agriculture in arid and semi-arid lands. The "dry" farmer depends upon the natural rainfall. He does not apply water artificially to his crop, but adopts methods which enable him to make the best use of moisture from the clouds, or, perhaps, from underground supplies. The success of " dry-farming " depends upon the amount of moisture available, the character of the soil, the methods of conserving the moisture, and the growing of drought-resisting plants. The principles for conserving moisture in " dry-farming " are two. First, the surface of the land under cultivation must be kept loose and finely pulverized. This forms a soil-mulch that permits the rains and melting snows to percolate readily through to the compacted soil beneath, and yet prevents the moisture stored in the ground from reaching the surface by capillary attraction and becoming absorbed by the hot, dry air. The second principle is to keep the subsoil finely pulverized and firmly compacted, thus increasing its water-holding capacity and its capillary attraction, and placing it in the best possible physical condition for the germination of seeds and the development of plant roots. In the west of the United States and in Alberta, many of the farmers successfully follow a system by which they raise a wheat crop once in two years, storing up water in alternate years. Where the rainfall is somewhat greater a crop is grown two out of three years. Arid South Africa would benefit by the application of " dry-farming " principles.

Mixed Farming. The raising of both stock and crops is carried on in all old cultivated and civilized lands, and to a certain extent in the " new " ; but, generally, one type is predominant. Thus, near cities, in thickly populated areas, and in damp, temperate climates dairying is predominant. Denmark is a huge dairy farm, and Cheshire and Shropshire supply the industrial towns of Lancashire, Yorkshire, and the Midlands with dairy produce. Where the climate is fairly dry and clayey-loams are found, crops usually prevail as in eastern England. In regions with the " Mediterranean" type of climate, the dry, sunny summers encourage fruit and cereal production, and animals are relatively of small importance. In China, Japan, the Ganges valley, and Belgium—regions of dense population—farms are very small, and careful spade cultivation needs to be practised. Extensive farming endeavours to obtain the greatest product for the least labour and expense, and can be carried on only in the sparsely populated " new " countries—Canada, the republics of South America, the west of the United States, and Australia—where labour is scarce and dear, where machinery can be used to advantage, where farms are often very large, and the land is very fertile and cheap. The soil is not carefully cultivated; rotation of crops is not practised; and manuring is almost unknown. Increase of population, however, slowly but surely turns the extensive farmer into the intensive. Agriculture is gaining in the grass-lands, and the purely pastoral industry is being driven to the drier lands. The romantic cow-boy is passing away, and soon the savannas will become the most productive and populous lands in the tropics. During recent years, small holdings and allotments have increased in number. Ownership of the soil by the cultivators is increasing, and this promises greater crop yields. Arthur Young says: "The magic of property turns sand into gold," and there is much truth in this statement, for the cultivator-owner is urged on by the joy that comes from possession and the hope of gain for himself. The future probably belongs to small farming. If so, the earth will one day be covered with small garden farms owned by their cultivators.

The farmer is concerned with the quantity and quality of life, and, throughout the history of civilization, he has produced the greatest architectural triumphs. Buddhism, Confucianism, and Brahminism arose in the eastern agricultural lands, and the patience and fatalism of eastern farmers are associated with the excellence of their arts and manufactures.

By intensive farming, man has made a great advance in saving energy. The scientific farmer acclimatises and breeds animals and plants suited to varied climates and soils; and improves their yield and quality by hybridization and scientific selection. Research work in phenology and bacterial life, weather-forecasting, the application of electricity to the soil, and the efforts now being made to discover the heat and rainfall constants of the cereals, will assuredly result in better returns to the future operations of farmers.

Lumbering. There is an enormous international trade in timber, notwithstanding the bulkiness of the product, and its consequent often heavy transport charges. The temperate forests are the most useful, for they provide timber which is reasonably durable, soft enough to be easily worked for constructional purposes, and the social nature of the trees makes certain types available in bulk, so that machinery and wholesale methods of exploitation may be employed. Soft pines, firs, and larches, and hard deciduous oak, elm, beech, and ash, grow in regions where vigorous races live, where the winter snowfall is great, and summer rains give constant summer streams. Transport is, therefore, relatively easy and cheap. "Roads," mere openings in the woods, can be made, and the winter snows by constant traffic and artificial waterings are turned into icy masses on which friction is small. Over these ice slides the logs are conveyed to the margins of the streams where they are piled high, and later the spring freshets transport them in the form of rafts to the saw-milling centres. Hard, tropical woods—mahogany, ebony, rosewood—much in demand for furniture on account of their durability and beauty, are often difficult of access, sometimes heavier than water, and are non-social in character. Thus, cheap transport is frequently impossible, and the varying depths of the rivers add to the difficulty.

Lumbering on a vast scale is carried on in Scandinavia, Russia, eastern and western Canada, the United States, and the interior forests of central Europe (more especially the Carpathian forests). The forests of Amuria and Kamchatka are, as yet, practically untouched. Among important timber trees are the redwood and Douglas pines of western North America; the walnut, cork-oak, and boxwood of Mediterranean lands; the valuable ebony and teak of India, Burma, and Java; the eucalyptus, turpentine, jarrah, and karri trees of the marginal forests of Australia, so useful for pier building; the kauri pine of New Zealand; the mahogany of Central America; the rosewood of Brazil; the "Gulf Pine" of Louisiana, Florida, and South Carolina; and the quebracho of Argentina and Paraguay.

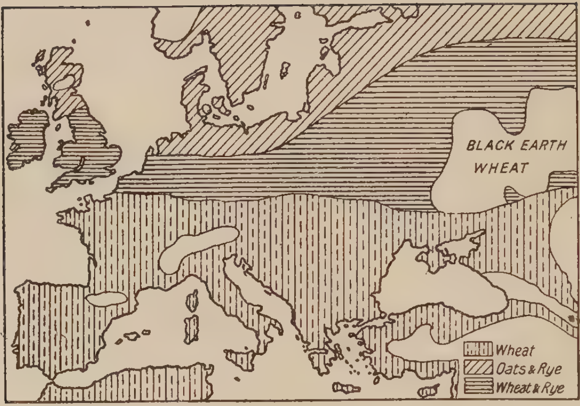
Immense quantities of soft timber from the cool temperate lands—woody fibres of the spruce and pine—are now required for paper-making; and so great has been the exploitation of the temperate forests for paper and timber purposes, that their conservation by scientific forestry is now very essential in Europe and North America.

CHAPTER V

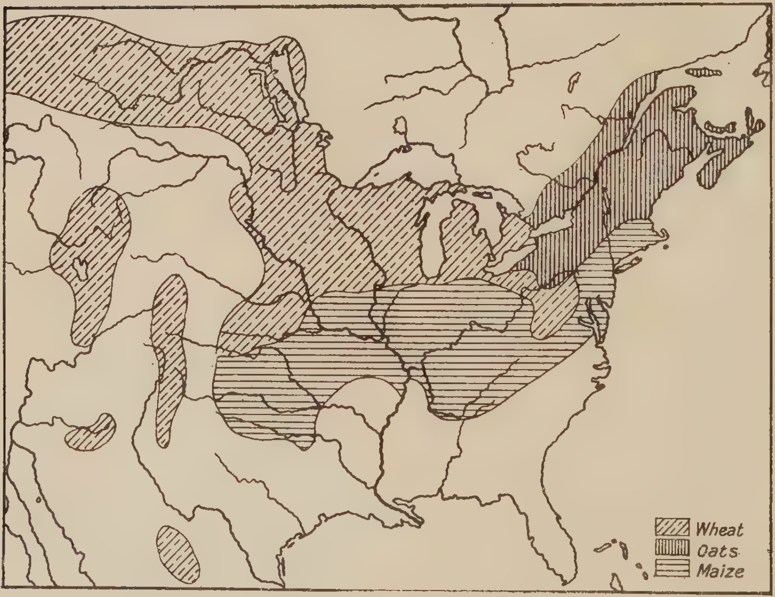
The World's Chief Agricultural Products

"Perfect agriculture is the true foundation of trade and industry; it is the foundation of the riches of states."—*Liebig.*

(*a*) **FOOD PRODUCTS (VEGETABLE).—Wheat.** This cereal is normally a winter annual and a product of temperate latitudes. It can be grown on practically any fertile soil; but the leading wheat lands are of the finer textures, such as heavy sand loams, silt loams, clay loams, and clays. These soils, while lifting water easily by capillarity, are freely traversed by air and percolating water, and are retentive of moisture. In regions like the interior of Russia and Canada, where the winter is too severe for the wheat plant to survive, spring wheats are grown. During the spring, showery weather prevails, with a rapidly rising temperature, and, as the season advances, both heat and dryness become extreme. The period of growth of spring wheats is of necessity short; they are frequently sown as late as April, or even in May, and the harvesting may take place in July; thus, the life period does not exceed five months, and is frequently much less. The grain of these "steppe" spring wheats is characterized by hardness, high gluten content, and by its ability to give a better loaf than the more slowly maturing starchy, autumn-sown winter wheats. Prof. Brewer admirably states the necessary climatic conditions for winter wheats: "The ideal climate is one with a long and rather wet winter, with little or no frost, prolonged into a cool and rather wet spring, which gradually fades into a warmer summer, the weather gradually growing drier as it grows warmer, with only comparatively light rains after the flowering of the crop, just enough to bring the grain to maturity, with abundant sunshine and rather dry air towards the harvest, but without dry and scorching winds until the grain is fully ripe, and then hot, dry, and rainless weather until the harvest is gathered." Drought-resisting Macaroni or Durum wheats, the hardest-grained wheats known, are grown under semi-arid conditions. In high latitudes, the length of the summer days and the high percentage of red and yellow light favours the growth of wheat; whereas the high percentage of blue and violet light in low latitudes is adverse to the plant.

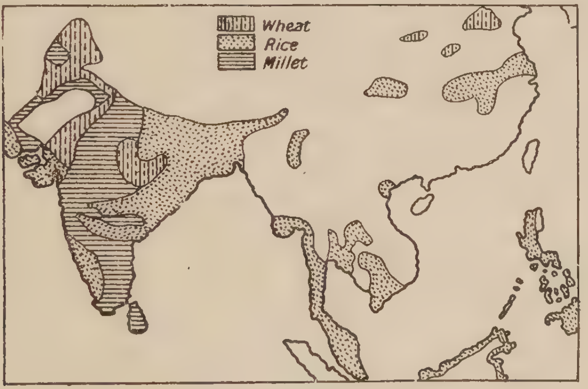


THE EUROPEAN GRANARY



THE NORTH AMERICAN GRANARY

In "new" lands, where wheat-growing is conducted on a commercial basis, the size of the farms is often very great, and extensive farming is the rule. Cultivation by one operation is usual on many of the "haciendas," "estancias," and "bonanza" farms. Gang ploughs, to which are attached broadcast seeders and harrows, and which are drawn by powerful traction-engines, make it possible to cover a large acreage. At harvest time, the combined harvester-thresher, worked either by steam or horse-power, not only cuts, gathers, threshes, and cleans the wheat, but even sacks the grain, without a touch from man's hand. The yield of grain per acre varies greatly, depending on farming methods, the fertility of the soil, climatic factors, and means of transportation. In Russia, Argentina, and India, the yield varies from nine to twelve bushels per acre; while in the countries of north-west Europe, yields of twenty to thirty-five bushels per acre are common.

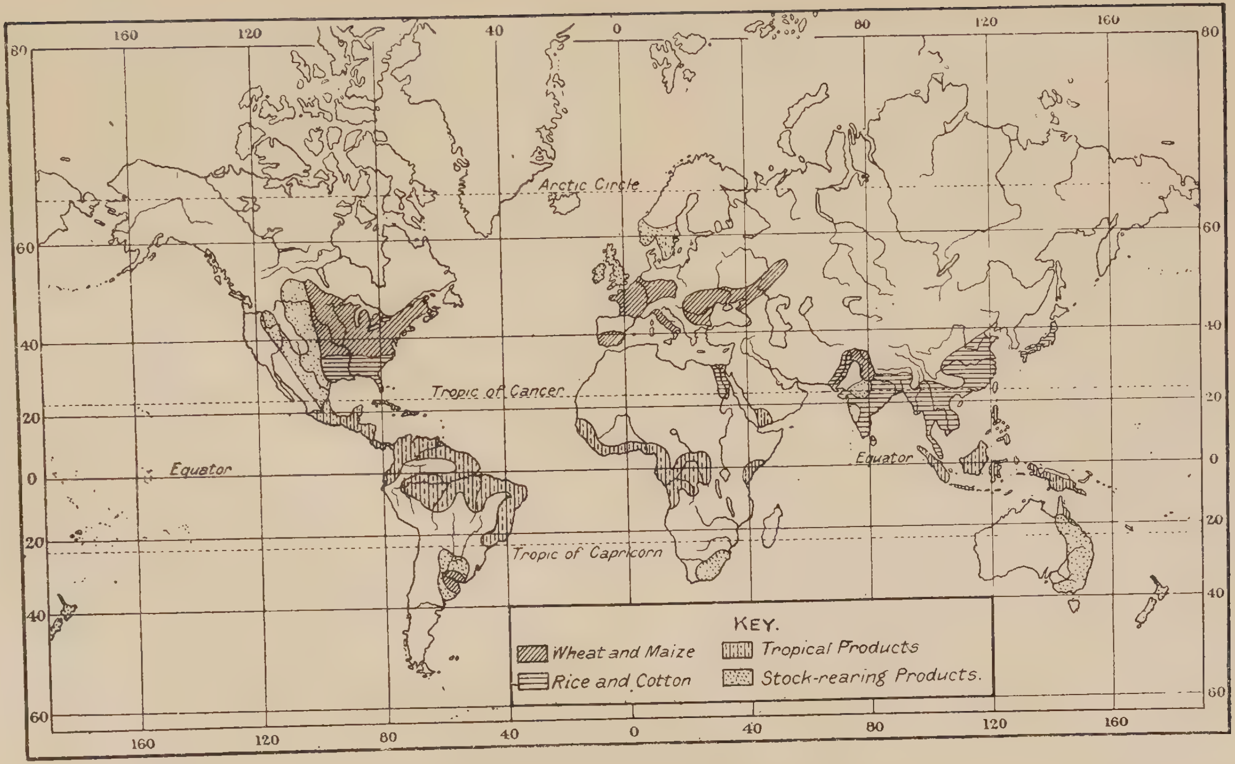


THE FAR EAST GRANARY

The great wheat-producing countries are the United States, the Ukraine, Russia-in-Europe, France, India, Siberia, Canada, and Argentina. In the United States the great wheat-belt lies south and west of the Great Lakes, embracing the States of Kansas, Nebraska, the Dakotas, and Minnesota. Ideal spring wheats are raised in this belt, while the Atlantic States produce winter wheats. The prairie belt of Canada is favoured both by climate and soil, and wheat is grown in great perfection for export. Early ripening wheats are being bred at the Government experimental stations, and the wheat-belt is pushing northward. The Hungarian "pusztas," the Wallachian Plain, and the rich "black" lands of southern Russia and the Ukraine, produce excellent wheats for export (in normal times); but the great production of France is needed for home consumption. In the Southern Hemisphere the La Plata grasslands have the largest production, Australian and South African supplies being less than South American and more uncertain. Siberia and Manchuria are not yet important exporters, but the probable increase of wheat consumers in the future, and the growth of transport facilities, should result in augmented production. Indian wheats are grown under irrigation in the Punjab as winter crops, and a high percentage of the production is exported. The fact that wheat is grown in so many different regions makes supplies more certain, and well distributed throughout the year. The chief exporting countries are the United States, whose export tends to decrease; Russia (normally), many of whose people are rye-eaters; sparsely populated Canada; the Argentine Republic, whose people are not great wheat-eaters; and India, whose people are rice- and millet-eaters.

Wheat is not only the most valuable of all the grains of temperate climates, but is also the chief bread-plant of the white races; and the demand for it tends to increase. Increased supplies will come from new regions, and from old regions cultivated more scientifically. Science promises to astonish the world by rendering aid in multiplying the yield of wheat (English Yeoman wheat has yielded 96 bushels to the acre), and in enabling food products to be manufactured in the laboratory; and the genius of invention may be able to accomplish the marvellous, by nitrogen obtained from the air, by the distribution of bacteria over the fields, or by utilizing the power of electricity.

Maize. Maize is a native of America. It requires deep, rich, warm, mellow soils, and higher summer temperatures than wheat. "The ideal climate is one with a summer from four and a half to seven months long, without frost, the middle portion hot both day and night, sunny skies, sufficient rains to supply the demands of a rapidly growing and luxuriant crop, falling at such intervals as best to provide moisture without ever making the soil actually



AGRICULTURAL PRODUCTS

wet."—*Professor Brewer.* Maize ranges from 50° N. to 40° S. lat., and is known as "Indian corn," and "corn" in America, "Turkish wheat" in Hungary, and "mealies" in South Africa. As a nutritious human food it is eaten in the form of "corn flour" and "hominy" in the United States, "polenta" in Italy, and "tortillas" in Mexico. It is largely employed in distilleries and in the manufacture of starch and glucose. Its peculiarly high fattening properties, and its prolific yield—twice as much grain to the acre as wheat—have caused its large employment in the rearing and fattening of live-stock. In the United States, maize is mainly grown in Nebraska, Iowa, Kansas, Missouri, Illinois, Indiana, and Ohio, but though quite three-fourths of the world's supply is produced in this area, the export is small, owing to the fact that it is more profitable to transform the grain into beef and pork. Argentina is a great exporter, and other important producing regions are Rumania, Hungary, Italy, India, Mexico, Brazil, South Africa, New South Wales, and Queensland.

Oats. Oats are more easily grown than wheat, but they need a cooler and moister climate than wheat needs. Almost any kind of soil suits them, though they yield best on a rich one. They are used chiefly as a food for horses, but are also consumed as human food in the form of cakes, porridge, and certain prepared foods. The United States, Russia, the British Isles, Germany, Austria, Italy, Hungary, Denmark, Scandinavia, Canada, France, Australia, and New Zealand are the chief producers.

Barley. This cereal prefers light calcareous soils, and thrives best under ideal "wheat" conditions. Its range in climate is, however, wider than that of any other cereal. It is found growing side by side with oats in lands too cold for wheat, as in Norway; and side by side with wheat in lands too dry for maize, as in most of the countries bordering the Mediterranean Sea. It was the chief bread-plant of the ancients, and is still a bread-stuff in Scandinavia; but it is mainly cultivated for the production of malt, which is used in beer-brewing and whisky-distilling. The chief producing countries are Russia, the United States, Germany, Austria, Hungary, India, France, Italy, China, Japan, Scandinavia, Denmark, Turkey, Rumania, the British Isles, and Spain.

Rye. This cereal requires less heat than wheat, and thrives in the poorest soils and in bleak climates where no other grain-crop prospers. It thus, naturally, became a boon, and the staple bread product of the poor soils and exposed areas of Scandinavia, Holland, north Germany, and central Russia. Besides its use as "black bread," it is used in the manufacture of Holland gin and Russian vodka. Rye is grown mainly as a green crop in the British Isles, only 1 per cent of the grain-growing land being devoted to it.

Rice. Rice yields more food per acre than any other grain, and is the characteristic grain crop of the thickly populated plains in monsoon Asia. Of the many varieties of this cereal, swamp rice is the most abundantly produced. It grows best with its feet in the water and its head in the sun. A high temperature and fields that may be flooded at will are essential, and these conditions are found ideally in the swampy river deltas and low-lying seaboard tracts of the summer rain areas of tropical and sub-tropical south-eastern Asia. "Upland" or "hill" rice thrives without flooding, but it forms a very small percentage of the production. Though much inferior to wheat in food value, its high productivity, ease of digestion, and need of cheap and patient labour, make it the chief bread-plant of the yellow races. The greatest rice-producing areas are India, China, Japan, Burma, the Malay Peninsula, the East and West Indies, Egypt, the plain of Lombardy, the lower Mississippi Valley, Madagascar, the coast-lands south of Zanzibar, the Niger Valley, the lower Amazon Valley, and Central America. The chief exporting countries are Burma, Cochin-China, Siam, Java and Italy, the teeming millions of India, China, and Japan consuming practically the whole of the home production.

Millet. This is the name given to several grain crops, most of which are tropical. They can be grown on poor soils, and with a moderate amount of moisture, and hence they are the very important "dry" crops of monsoon lands. The two kinds most largely grown are the Great Millet and the Spiked Millet, which form two of the leading crops of India. In Africa, Great Millet is known as Guinea corn or durrah. Millet figures little in commerce, being grown mainly for local consumption.

Buckwheat. This is the fruit of a herbaceous plant, similar in appearance to the common sorrel. The grain quickly matures, and is very nutritious. It is used for feeding cattle and poultry, and the flour for cakes. The plant can be grown on the poorest soils, but the yield is uncertain. Russia, Japan, France, and the United States are the chief producers.

Pulses. The term pulse is used for certain pod-fruits, rich in nitrogenous food, and capable of being used as food by man or cattle. Among the chief pulses of commerce are common peas, beans, chick-peas, soya beans, and the fruits of the carob or locust and mezquite trees. Vegetarians, especially the monsoon peoples, are great consumers of pulses. Peas are largely grown in the less warm parts of the Temperate Zone; while the many varieties of beans are cultivated over a wider range, though production is greatest where the "Mediterranean" climate prevails. Chick-peas are important in south Europe, north Africa, and India; and soya beans are largely grown in Manchuria, Japan, India, Cochin-China, and Java. Lentils, vetches, and lupines are cultivated in the Mediterranean lands and India, and locust, the fruit of the carob tree, is specially abundant in Cyprus. Mezquite trees are abundant in north Mexico, and in the United States from Texas to California.

Potatoes. The potato tuber is a native of the high and dry Andean plateaux from Chile to Venezuela and the damp districts of south Chile; but its remarkable powers of acclimatization make its cultivation possible from the tropics to the farthest limits of agriculture, even beyond the polar limits of barley. It tolerates almost any soil except heavy clays, but prefers a light, sandy soil. Potatoes are an important article of diet of Europeans, and in eastern Germany and Ireland they form the staple food of the peasants. Besides their use as food, potatoes are used in the production of starch, glucose, and alcohol. Germany, Austria, Hungary, Russia, France, the United States, the British Isles, Poland, Czecho-Slovakia, and Italy are the greatest producers. There is little long distance commerce in potatoes owing to their bulk and cheapness.

Sago. This is obtained from the pith of the sago palm, which grows to a height of thirty or forty feet, and flourishes in hot, swampy districts. It is easily cultivated, and gives very large yields, a single tree producing as much as 900 lb. The trees are felled just as they begin to flower, the trunks are cut open, and then the white pith is extracted, powdered, and mixed with water. It is then drained and coarse sago is left. For export the moist sago is rubbed through sieves of varying degrees of fineness, thus forming the pearl, medium, or bullet sago. Sago forms the chief food of thousands of the natives of the Malay Archipelago and the tropical Pacific Islands.

Tapioca, Cassava, Manioc. Manioc or Cassava is a tropical product, growing in the form of a shrub about six feet high. It is a native of Brazil, but has been introduced into West Africa and Malaya. Sweet cassava root is eaten as a vegetable, but the bitter cassava root, which is the more important, is poisonous, and needs to be subjected to heat and pressure, when the resulting meal is the non-poisonous and highly nutritious tapioca of commerce.

Arrowroot. This is the starch obtained from the roots of various tropical plants. True arrowroot, however, is obtained from the rhizomes of the Maranta arundinaceae, a plant, two to three feet high, native to the West Indies. It is exported chiefly from the West Indies (St. Vincent, the Bermudas and Jamaica), the East Indies, Natal, Queensland, and Bengal.

Onions. These bulbous plants with pungent odour are cultivated over a very wide range of latitude, extending from the north of the Temperate Zone to the tropics. There are a large number of varieties, but those of Spain, Portugal, British Columbia, Holland, and Egypt are the best known.

(*b*) **SUGAR, CONDIMENTS, AND SPICES.—Sugar.** Sugar is obtained chiefly from the sugar-cane and white sugar-beet ; but is also derived from the sap of the maple tree in Canada and the United States, millet, sorghum, and maize in China and the United States, and from the date, coco-nut, sago, and Palmyra palms in tropical lands. The *sugar-cane* is a kind of tropical grass, which grows from ten to twenty feet high. It cannot stand frost, and since a great deal of hand labour is necessary in its cultivation, generally it is grown only where coloured labour is cheap and plentiful. The plant is not cultivated for its seeds, but for the rich juice contained in its stem. For mature development, the plant needs abundant heat, very moist soils rich in humus and derived from volcanic, coralline or crystalline rocks, salt in the air and the soil, and a lowland situation. The stalks, which may attain a thickness of more than an inch, are cut down annually just before flowering ; but the perennial roots throw up fresh stalks every year in sufficient quantity to make cultivation remunerative for thirty years in succession. The best method is to grow the cane from cuttings. *Sugar-beet*, produced from seed, thrives in comparatively poor soils, and requires a temperate climate. In the case of the sugar-cane the juice is obtained by crushing the stems between heavy rollers; while beet is sliced and then soaked in hot water. Sugar is obtained from the juice of the sugar-cane by evaporation and crystallization. The syrupy residue is known as molasses, and the yellow crystallized sugar is further treated and refined.

It must be noted that cane needs less attention than beet, that its juice is of superior richness in sugar, and that tropical labour is cheap; but that transport charges are high, methods of manufacture are sometimes primitive, and markets are distant. Beet can be grown where sugar is most heavily consumed, where capital for the best machinery is abundantly available, and beet refuse after the extraction of the sugar forms a very valuable cattle-food. It needs, however, scientific cultivation, re-planting each year, and the labour employed is dear. Beet is sometimes aided by bounties, but can rival cane without any artificial aid.

Cane-sugar is supplied chiefly by Cuba, Java, and Hawaii. Considerable quantities are, however, produced in India, Puerto-Rico, the Guianas, Brazil, Mauritius, China, Egypt, Natal, Queensland, the East and West Indies, the Mississippi plain and delta, the Philippines, and Peru. Beet-sugar is now mainly manufactured in Holland, Belgium, north France, north Germany, Austria, Russia, the United States, Canada, Czecho-Slovakia, and Poland. In England, beet-growing is in the experimental stages.

Spices, Condiments, and Flavourings. These are products mainly of hot lands, though mustard and caraway are exceptions. From the remotest ages they have been in great demand for embalming, as incense, and in making more palatable poorly cooked and salted and dried meats. They are usually gathered in the unripe state in order to secure the maximum flavour. Poets have sung of fragrant spices, counting them among the good things of life. The *pepper* of commerce—peppercorns, black and white pepper—is derived from the fruit of a twining and climbing plant, belonging to southern India, Indo-China, Malaya, Ceylon, Kenya Colony, and the East and West Indies. *Black pepper* is obtained by crushing the whole berries; while, for *white pepper*, the husk is first removed. *Cayenne* or *red pepper* is the ground pods of different species of Capsicum, one of which has smaller pods and is used entire in pickling, under the name of *chillies*. Though indigenous to South America, red pepper is successfully cultivated in the East and West Indies, Central America, West and East Africa, Spain, southern France, and Hungary. *Ginger* is the dried rhizome of a plant native to the East Indies, but now largely cultivated in British India, Jamaica (finest), Sierra Leone, China, and Indo-China. *Cinnamon*, useful as a spice and a medicine, is the rolled inner bark of the Cingalese cinnamon tree, and also of similar growths from the cassia tree of China and Burma. The chief supplies come from Ceylon (the best), the Seychelles, Java, the West Indies, Senegal, and India. *Cloves* are the dried, unopened flower-buds of an evergreen tree, native to the Moluccas, but now produced largely in Zanzibar, Pemba, Penang, the East and West Indies, the Seychelles, India, and Ceylon. *Nutmeg*, the kernel of a peach-like fruit, and its covering layer, *mace*, are the products of a tropical tree, growing in the Moluccas, Grenada, Penang, and Ceylon. *Pimento*, or *allspice*, is obtained from the unripe dried berries of a tropical plant, largely cultivated in the West Indies, especially in Jamaica. *Vanilla*, used as a flavouring in confectionery, is the pod of a twining orchid indigenous to Mexico and South America, and now largely produced in Mexico, Guadeloupe, Réunion, Madagascar, Mauritius, Tahiti, Bourbon, India, Ceylon, the Seychelles, the Comores, and Java. *White* and *black mustard*, commercially the most important condiments, are grown in the East Indies, Asia Minor, Holland, and eastern England. *Aniseed*, indigenous to Egypt, is produced also in Germany, southern Europe, and the East Indies. *Fennel*, *coriander seeds*, and *caraway seeds* are products of temperate latitudes, chiefly European. *Capers*, the flower-buds of the caper-bush, are grown principally in Mediterranean Europe.

(*c*) **FRUITS.**—The distribution of the chief fruits of commerce is very closely regional. The *apple* is the tree fruit capable of cultivation in the highest latitudes and altitudes. In Norway and Russia it is grown as far north as 65°. It is a "continental" product, flourishing best where the spring is so short that the plant cannot make both wood and fruit successfully, and where the sudden and short autumn stops the rising of the sap directly the crop has been gathered. Dry, sunny weather in the late summer and early autumn adds to the lusciousness of the fruit. Central Europe, Normandy, the glaciated region round Lakes Erie and Ontario, the States of New York, Pennsylvania, Ohio, and Delaware, the western margin of North America from British Columbia (Okanagan Valley) to California, the Minas and Annapolis basins of Nova Scotia, Tasmania (Huon Valley), Australia, New Zealand, China, and Japan, are the chief producing areas. *Pears* and the *stone-fruits* of temperate and sub-tropical climes—plums, apricots, and peaches—show a similar distribution, British Columbia, California, Tasmania, Jugo-Slavia, Austria, South Africa, Ontario, and France having a large production. The bulk of the fruit trade of the United Kingdom is in southern or "Mediterranean" fruits, comprising ~~oranges~~, ~~lemons~~, ~~citrons~~, grapes, ~~currants~~, ~~raisins~~, ~~figs~~, almonds, and edible nuts. The *orange*, originally a product of the monsoon summer rain region of south-eastern Asia, has been acclimatized to summer drought, and to tropical and sub-tropical climates. It ranges from Paraguay to Japan, and from New South Wales to California. Spain, Italy, Sicily, Malta, the Azores, the West Indies, Florida, California, Algeria, Brazil, Queensland, Asiatic Turkey, South Africa, and Java produce large quantities; and the Maltese, Denia, Palermo, Jaffa, Azores (St. Michael), Seville, Tangerine, Florida, Jamaican, and West Indian types are the most celebrated. *Lemons*, more exotic than oranges, are exported largely from Sicily (Messina), Italy, Spain (Murcia), Portugal, California, and Florida; the smaller-fruited *lime* is exported from Dominica, Natal, and Queensland; and the large thick-rinded *citron*, now largely ousted by the lemon, comes chiefly from the countries bordering the Mediterranean Sea, Japan, and India. The *fig tree* is not so sensitive as the orange to frost, and the fruit is more easily transported. Spain, Italy, and Asiatic Turkey are the chief exporters. *Grapes* as a fruit are exported from those districts which do not produce a grape suitable for wine-making. The Cape of Good Hope Province, Spain, and Portugal largely export them. *Raisins*—sun-dried grapes—are produced chiefly in Spain, Asiatic Turkey, Australia, Egypt, California, British India, Cyprus, and the Cape

Province; the scalded Valencia raisins, the muscatels of Egypt, and the seedless sultanas of Asiatic Turkey are well known. *Currants* are the dried form of a small seedless grape obtained from a variety of vine which requires to be grown near the sea. This vine is almost confined to Greece and the Aegean and Ionian Islands, but currant production is increasing in Australia. There are two kinds of *almonds*—bitter and sweet—the former yields oil of bitter almonds; the latter is usually eaten for dessert. The chief exporting countries are Spain, Morocco, Italy, Portugal, France, California, and Palestine. *Chestnuts*, *walnuts*, the *black mulberry*, the *pomegranate*, the *pistachio nut*, and the fruit of the *olive* tree, are the products chiefly of southern Europe and northern Africa. The *banana*, one of the most nutritious and prolific of food plants, is the product of a marine climate, and enters commerce in the form of the dwarf Canary, the larger Jamaican varieties, and the claret variety of Trinidad. The banana belt encircles the earth for 1,500 miles on either side of the Equator, the chief sources being the West Indies, the Canary Islands, tropical Africa, Costa Rica, Colombia, Honduras, Guatemala, Egypt, and north Australia. *Pine-apples* need great summer heat and freedom from winter frosts; they are grown mainly in the Azores, the West Indies, Florida, Natal, Malaya, Hawaii, and Queensland. *Dates* and *coco-nuts* are lovers respectively of dry heat and damp heat. The former is a characteristic product of the hot desert and semi-desert regions in Asia and Africa, ranging from India through Persia, Irak and Arabia to north Africa; while the latter is typically oceanic, being grown in perfection on the Malabar coast of India, and on the islands of the Indian and Pacific Oceans.

Refrigeration has made it possible to bring even the most delicate fruits from distant parts of the world without deterioration, and fruit is now an important article of diet in highly-civilized lands. Canned, bottled, and dried fruits also enter largely into the fruit trade.

(*d*) **BEVERAGES (NON-ALCOHOLIC).—Tea, Coffee and Cacao.** Valuable on account of their stimulating properties, these beverages require rich, light, friable soils, with abundance of humus; frequent heavy rains; well-drained sub-soils; and cheap and skilful labour. They all derive great benefit from shade, and compel the planters to wait a considerable period before receiving a return on the capital expended.

TEA. A hardy sub-tropical plant, tea is capable of standing severe frosts, and its value lies in the leaf. There are two kinds of tea plants, the highland, which furnishes the finer quality; and the lowland, which is the more productive. The plant thrives best in the sub-tropical parts of the monsoon lands which have some rain in winter as well as in summer. Leafage seems to be dependent on the presence in the soil of organic matter and nitrogen, and quality on that of phosphoric acid and potash; the planters are compelled to supply these elements as rotation of crops is impossible. The hillsides, once covered by monsoon forests, form ideal sites for tea-plantations on account of the suitability of the soil and the perfect drainage. Planters restrict the height of the plant, the usual height being from 3 to 8 ft. The plant comes into full bearing in the fifth year, but after the third year the leaves are picked several times during the year. Careful, skilful, and cheap hand-labour is essential in the picking, drying, and fermenting processes, and in the packing of the commodity for the world markets. Both black and green teas may be made from the leaves of the same tree, the difference being entirely due to fermentation taking place in the manufacture of black tea and not in that of green tea. India, Ceylon, China, Japan, Java, Natal, and Fiji are the most important producing regions. Indian teas, noted for their strength, are grown mainly in Assam, Darjeeling, the Punjab, Travancore, and Nilgiri. Tea is the chief crop of Ceylon, little else being cultivated at altitudes above 2,500 ft. Chinese teas, noted for their herby flavour, are produced mainly in the lower Yangtse basin. Japan grows her tea in the centre and south, and the famous black, peach-scented Oolong tea which she exports to the United States is grown in Formosa. Java tea is of inferior quality owing to the lack of potash and phosphoric acid in the soil. The dust and siftings of ordinary black and green teas are compressed by machinery into slabs 1½ to 2 lb. in weight, and exported from Hankow to Russia. Inferior brick-tea, made from the poorer tea-leaves, stalks, twigs, and clippings, is exported from Szechwan to Tibet.

COFFEE. Like tea, coffee is of two main varieties, the "Arabian" highland kind being the finer in aroma, and the "Liberian" lowland type the more prolific. When left to itself the coffee tree attains a height of 20 ft. or more, but in cultivation it is not allowed to grow higher than 8 or 10 ft. The tree reaches maturity in six years, and bears fruit for thirty years or more. It is grown at lower levels than tea; requires tropical heat, and shelter from violent winds and too direct sun heat; and cannot stand continued frost. Its value is in the fruit, the most perfect specimens of which are products of dry and hot areas, where the berries are allowed to mature until they drop off. Banana and rubber trees provide shade in western tropical America, while, on the slopes of the Brazilian highlands, a tall plant of the "pea" family gives the necessary shade. On the higher Red Sea slopes of the Arabian plateau, Mocha coffee plantations are screened daily by the mid-day mists which rise with almost unfailing regularity from the steaming waters which wash the Yemen coast. South America controls the world's coffee trade, Brazil producing in some years over 70 per cent of the world's crop in the States of São Paulo, Rio de Janeiro, Espirito Santo, and Minas Geraes. Bolivian, Mocha, Jamaica, Guatemala, Costa Rica, and Mysore coffees are of excellent quality; and Haiti, San Domingo, Mexico, Java, India, Colombia, Nicaragua, the East Indies, Malaya, Venezuela, Nyasaland, Uganda, and Hawaii produce coffee of good quality. Brazilian coffee is of inferior quality, and to it are sometimes added small quantities of the finer varieties. Coffee-growing in Ceylon has been abandoned almost completely owing to the ravages of insects and fungi, and the wonderful success in tea-growing.

CACAO, OR COCOA. The cacao tree is indigenous to Mexico, Central America, and part of South America; but has been introduced into other equatorial regions. It is essentially an equatorial product growing in areas 15° on either side of the Equator, and rarely higher than 650 ft. above sea-level. The tree in the natural state grows to about 20 ft. high, but under cultivation is pruned to make harvesting easy. It is peculiarly sensitive to winds of all kinds, and especially winds which have passed over salt water; prefers volcanic soil; and requires much moisture and protection from direct exposure to the equatorial sun. The deep, moist, volcanic valleys of Central America and the northern Andes, and the Selva lowlands are ideal sites for cacao plantations. After four or five years the plant comes into bearing, and fruits for about thirty years. Cacao enters commerce in the form of fermented and sun-dried cacao beans, which are the seeds contained, to the number of 30 to 50, in a cucumber-shaped pod, 5 to 10 in. long and 3 to 4 in. thick. The Gold Coast Colony leads in production, and is followed by Ecuador, Venezuela, the West Indies, Trinidad, Brazil, San Domingo, Nigeria, São Thomé, and Principe. Less labour is required to prepare cacao for export than is necessary for tea or coffee, and hence it is successfully grown in regions where the other beverages are excluded by lack of population.

YERBA MATÉ OR PARAGUAYAN TEA. This is an infusion prepared from the dried leaves of the South American holly, an evergreen plant, 12 to 26 ft. high, which grows spontaneously in the Brazilian States of Parana, Santa Catharina, Rio Grande do Sul, and Matto Grosso; in the north-eastern region of Argentina; and especially in east and central Paraguay. It is said to be more sustaining than tea or coffee.

(*e*) **BEVERAGES (ALCOHOLIC).—Wine.** Vine-growing is a species of horticulture dependent on dense population, inherited skill, and abundant capital. Climatically, the vine needs a long warm summer and fairly great sun heat in the late summer and early autumn; edaphically, it requires warm soils retentive of moisture, such as chalk and limestone. The long roots of the plant enable it to resist both drought and frost; but sun-heat has great effect on the quality of the wine, for where it is too great the wine is too syrupy, and where it is too little it is vinegary. The ideal site for vineyards is a slope of from 30° to 45°, facing eastward as well as sunward in latitude 40° to 50° N., and the thermally equivalent 30° to 40° S. France easily leads the world in the quality and quantity of its wine production. The industry suffered severely towards the close of last century from the ravages of the phylloxera, an insect pest that ruins the vine on which it feeds; but the trouble has now largely been overcome. The dry, warm valley slopes of Champagne and Burgundy produce the well-known brands; the Bordeaux district is famed for its clarets; Cognac, in Charente, produces the brandy (spirit distilled from wine), which is the richest of all in organic ethers; and Guienne, the Loire Valley, and the south coast are important producing areas. Algerian wines are largely sent to France to be blended with French wines. The vine is particularly important on the dry and sunny Appennine slopes of Italy, and Italy ranks after France as a wine-producer. Italian wines are generally ill-prepared, although the Marsala of Sicily, the Capri of Naples, the Chianti of Florence, the Asti of the Piedmontese hills, and the Lachrymae Christi enjoy a high reputation. Sherry, a wine very rich in organic ethers, is produced in the neighbourhood of Cadiz, and other noted Spanish wines are those of Malaga, Alicante, and Tarragona. Portuguese wines, exported from Oporto, under the name of *port*, are grown chiefly in the basin of the Douro. Hungary specializes in Carlowitz and Tokay, fine liqueur wines, sweet and syrupy. Hock and Moselle are German wines, but the total output is small. Some of the finest liqueurs are prepared by the Benedictine monks in Picardy, and those of Chartreuse in Savoy. Central Chile, South Australia, Victoria, New South Wales, the Cape of Good Hope Province, Mendoza, and San Juan (Argentina), and south-west Russia also produce wines; those of South Africa and Australia are steadily improving in quality and quantity, and gaining markets in Europe.

Hops. The hop is a perennial plant which sends out twining stems, and requires a very rich soil. Its clusters of small greenish flowers are used as a seasoning for beer. It is grown largely in the western marginal lands of Europe.

Rum. Rum is prepared by fermenting molasses or sugar-cane sap. Its dark colour is produced by the addition of burnt sugar. Jamaica and Guiana rums are the best known.

Whisky. This spirit, which is made for the most part in Scotland and Ireland, is obtained mainly by distillation from malted barley; but inferior whisky is sometimes prepared from maize, rye, and potatoes.

Gin. Gin is produced by the distillation of malted liquor with the addition of oil of juniper; and is made principally in Holland (Schiedam) and London.

Cider. This is a fermented liquor manufactured from the juice of apples in western Europe and Canada, while perry is produced in the same regions from pears.

Beer. Beer, the favourite native beverage in north-western Europe, is made from grain, usually barley, converted into malt by changing the starch into sugar, then mixing with hard water and fermenting. The resulting liquor is flavoured with hops. Large quantities of spirits are made in Russia and Germany from potatoes, in Rumania from plums, and in Holland from the outer rind of the Curaçao orange. Practically every plant can be made to yield alcohol, and numerous fruits and plants are used for this purpose. *Vinegar* is made by the slow or rapid oxidation of the alcohol in beer (malt vinegar) or wine (white vinegar). Inferior vinegars are produced by the distillation of wood.

(*f*) **TOBACCO AND DRUGS.—Tobacco.** The tobacco of commerce is the dried and prepared leaves of three species of the genus Nicotiana. The original American plant, Nicotiana tabacum, which supplies $\frac{7}{8}$ths of the world's supply, grows from 2 to 9 ft. high, according to variety, and produces several clusters of beautiful pink flowers. Nicotiana rustica, hardier than Nicotiana tabacum, bears greenish-coloured flowers, and is cultivated in Europe, Asia, Africa, and Mexico, its most noted varieties being Latakia, Turkish, Syrian, and Hungarian. Nicotiana persica is mainly grown in Persia, and yields the mild Shiraz tobacco. Though native to tropical America and sensitive to frost, most tobacco is raised in temperate climates. It thrives best on a light soil (alluvial or light loam) that is rich in lime, humus and potash. Very few plants are as susceptible to culture and climatic conditions as tobacco. It is said that leaf grown from seed of the fine-textured Cuban cigar tobacco, planted in the northern United States, in a very few generations becomes changed to a thick-textured tobacco, even when every care is taken. The best cigars are made from the fresh leaf of "marine" tobaccos (Cuba, Sumatra, and Manila); the best pipe tobaccos are manufactured from "continental" tobaccos (the basins of the Ohio, the upper Danube, and the upper Garonne); while "Mediterranean" and "semi-marine" tobaccos (Syria, Greece, Anatolia, Egypt, and Virginia) are the best for cigarettes. In each case, however, the quality of the leaf varies with the soil. Heavy soils produce strong tobaccos, and light ones mild. The percentage of nicotine, which varies from 2 per cent in a good Cuban leaf to 9 per cent in a German leaf, is probably a climatic result. The chief producing countries are the United States, the Dutch East Indies, Brazil, Mexico, Cuba, Central America, northern South America, the West Indies, the Philippines, Austria, Hungary, Russia, Germany, Turkey, Greece, Syria, Egypt, India, China, Japan, France, Australia, Rhodesia, Bulgaria, Italy, Canada, and the Transvaal.

Opium. Opium is the dried latex from the seed pod of the white poppy, which is grown in India, Egypt, Asia Minor, Persia, China, Malaya, the East Indies, and Turkey. Opium is one of the most precious of all drugs, for it contains an element (morphia) which induces sleep and relieves pain. Its intemperate use is very harmful, and attempts have been made to prohibit opium smoking, especially in China.

Cinchona and Quinine. Cinchona is the name of a Linnaean genus of tropical trees, several species of which yield a bark invaluable in medicine. The medicinal extracts from the bark are known as quinine, and the less reliable cinchonine. Quinine is valued most of all for its healing virtues in cases of fever and malarial affections of all kinds. The species of cinchona are all natives of the eastern slopes of the Andes from 20° S. to 10° N. lat. They all need a mild and equable climate, such as that suitable for coffee and cacao trees. The trees are now, however, grown successfully in many tropical regions of the Old World; and the chief sources of supply are Colombia, Jamaica, the Western Ghats, southern India, Sikkim, Burma, Ceylon, and Java.

Atropine. Widely used in the examination of the eye, atropine is obtained from the deadly nightshade plant, which is extensively grown on waste stony places in southern Europe.

Oil of Eucalyptus. A very valuable antiseptic drug, oil of eucalyptus is obtained from the leaves of the Australian Blue Gum, which sometimes attains the height of over 400 ft.

Camphor. A white, translucent substance, camphor is obtained from the wood of the camphor laurel of China, Formosa, Japan, the Cape of Good Hope Province, and Jamaica. The wood of the tree is cut up into chips, and exposed to the steam of boiling water. The camphor vapour rises from the wood, and is then condensed. This crude camphor is exported, and is afterwards refined. Japan controls over 90 per cent of the world's supply.

Cocaine. An anaesthetic and in small quantities a stimulant, cocaine is prepared from the leaves of the coca plant, which is cultivated in Peru, Bolivia, Java, and Malaya.

(*g*) **OIL SEEDS AND OILS.**—Oils are divided into three main classes—fatty or fixed oils, essential or volatile oils, and mineral oils. The fixed oils will not light easily, are greasy on a piece of paper, and usually solidify into fat without much difficulty. They include many oils obtained by crushing seeds, such as olive, linseed, and castor, as well as all kinds of wax, the animal fats, and the fish oils. The essential oils include vegetable oils, which are usually contained in the plant itself. They are not greasy, light easily, and generally have strong smells and tastes. Mint, aniseed, clove, and turpentine are among the best known. Mineral oils are obtained from rock under the soil, the most important being petroleum.

Palm Oil. This vegetable oil is obtained from the fermented fruit of several species of African palm trees. The best known is the Guinea oil tree, which, unlike the coco-nut palm, does not like the sandy shore of the sea, but prefers a rich moist soil. In West Africa the great oil forests do not begin till two or three miles inland, and flourish best when the mean annual rainfall is not less than 70 in., and the mean annual temperature is not less than 70° F. Palm oil is used chiefly in the preparation of soap and candles.

Palm-kernel Oil. This is the oil extracted from the kernels of palm nuts. It is largely used for making margarine and other edible butters and fats.

Coconut Oil. The coconut palm is truly tropical and almost equatorial, flourishing on sandy shores within 15° of the equator. It comes into bearing when six or seven years old, and will then produce seventy or more nuts per year for more than fifty years. The nut contains, inside a hard shell, a layer of sweet gelatinous matter which ripens to a hard solid, and this exposed to a tropical sun forms the "còpra" of commerce. To obtain the oil, the copra is broken up and ground to a meal, then heated and heavily pressed. The residue of cake is used as a cattle food. Ceylon, India, Malaya, Australia, the West Indies, Mauritius, Fiji, and other islands of the Pacific, Kenya Colony, Zanzibar, and the Gold Coast are the chief sources of supply. Coconut oil is one of the most important constituents of margarine.

Castor Oil. The castor oil plant in tropical climates attains a height of 40 ft., but in more temperate lands it becomes a bush.

Its seeds when placed under a powerful hydraulic press yield a whitish oily liquid, which is used as a safe aperient and for soap-making ; the chief sources of supply are India, Java, California, Italy, and southern China.

Colza Oil. This is obtained from the seeds of two species of rape, which are widely cultivated in central Europe, northern India, China, and Argentina. The oil is chiefly used for burning in lamps, and for lubricating machinery.

Olive Oil. This oil is present in the fruit and stone of the olive. The tree is typically " Mediterranean," its fruit growing during the short winter-spring wet season, and ripening in the dry summer. To obtain the best oil, the barely ripe fruit is hand-picked and the pulp subjected to very gentle pressure. Subsequently, the fruit is re-compressed a second and third time, yielding an increasingly impure oil. As a substitute for milk and butter, olive oil is very important in " Mediterranean " areas. It is also used as a table oil for cooking and preserving, and in soap-making. Italy, France, and Spain are the chief sources of supplies. The best oil comes from the south of France (Provence oil) and Tuscany (Lucca oil).

Ground-nut Oil. This is obtained from the nuts of the leguminous ground-nut plant, which is cultivated in India, West Africa, the West Indies, the Sudan, Malaya, Kenya Colony, Uganda, Natal, monsoon Asia, Argentina, Mediterranean Europe and Africa, and the United States. The oil is used in soap-making, and in the refined and purified form as salad oil.

Sesamé Oil or Gingelly Oil. The seeds of Sesamum indicum, an annual which grows about 4 ft. high, yield more than half their weight of oil. The plant is cultivated in Egypt, Asia Minor, India, Kenya Colony, Uganda, West Africa, Brazil, Mexico, and the West Indies. The best oil is used in making margarine, the lower grades for soap and burning-oil.

Linseed Oil. This oil is extracted from the crushed seeds of the flax plant, which is largely grown in Argentina, Italy, the United States, Russia, and India. It is chiefly used in the preparation of paints and varnishes, and in making soap, oil-cloth, and linoleum.

Soya Bean Oil. This is obtained from the seeds of Glycine soya, which grows in Manchuria, China, Japan, and south-eastern Asia generally. It is used for rubber substitute, soft soap, and lamp oil.

(*h*) **FIBRE PLANTS.—Cotton.** The raw cotton of commerce consists of the woolly tufts of fibre contained in the seed-pods of a sub-tropical plant, which requires for its perfect culture light limestone soils or fine sandy loams, safety from frost, salt in the soil or in the air, a moderately high and even temperature and humidity, six to seven months of warm weather, maximum of sunshine by day and heavy dews by night, frequent light showers shortly after sowing, a careful selection of seed, and a scientific use of fertilizing agents. Such a combination of conditions is rarely found, so that the best cotton is limited in quantity and readily commands a high price. Bacterial, fungoid, and insect organisms, especially the cotton-boll weevil, have caused much damage to the crop in the past, but scientific research will, doubtless, eventually find the remedies.

The best of all cottons is that gathered from the Gossypium Barbadense, and known as Sea Island cotton, from the fact that in the United States it was first grown on the string of flat islands lining the coasts of Georgia and South Carolina. For more than a century this has been the only cotton suitable for spinning the very finest counts and qualities of yarn. It has the longest, finest, and strongest fibres, and the most beautiful silky appearance in the mass. The length of the staple may be as much as two and a half inches, and the average is over one and a half inches. To-day, the very best Sea Island cotton grows only on certain islands off the coast of South Carolina (James, Edisto, and St. John's), near the port of Charleston, and in the West Indies. Next to this come the Egyptian Sakel and Jannovitch varieties, and certain lower grades of Sea Island, known as Floridas and Georgias, because they are grown in the landward districts of those states, not far from the sea. Peruvian cotton from the coastal plain, the fibre of Gossypium Peruvianum, is also of excellent quality, and the demand for it exceeds the supply. Brazilian cotton resembles the West Indian in length, but the excessive heat makes it much coarser.

Both in the Old World and the New, the species of cotton now most widely cultivated is the Gossypium Herbaceum, which yields "Upland" cotton, an inland product whose staple is about one inch. The marine Sea Island and the continental "Upland" varieties of cotton differ materially in their seed characteristics.

The former has a small black seed from which the lint separates readily; while the latter has large seeds, which are greenish in colour and are surrounded by a short dense fuzz beneath the long and more valuable lint. Both of the species are perennial in climates without frost, but in cultivation they are treated as annuals. The plants are shrubby, three to ten feet high, more or less branched, and bear large alternate three-to five-lobed leaves, which, when held to the light, show numerous pellucid dots. The flowers, which resemble closely those of the hollyhock, mallow, and hibiscus, are white when newly open in the varieties of "Upland" cotton, turning red with age, and creamy yellow in the Sea Island, with a purplish spot at the base of the petals. The flower develops into the "boll," which contains the seed and the white or brown floss. Picking and ginning operations demand cheap labour and machinery. Viewed under a good microscope, cotton fibre appears to be an irregular, flattened, twisted tube, the edges of which are somewhat thickened and corrugated. This twist distinguishes cotton from all other plants, and it is to this character that its superior qualities for spinning are due. The fibre varies from one-quarter to over two inches in length; the bulk of the Indian crop averages half an inch, that of the United States one inch, the Egyptian under one and a half inches, and the West Indian over one and a half inches.

"Upland" American cotton furnishes the bulk of the world's output, an area about half that of Britain being devoted to its cultivation. The cotton belt stretches 500 miles from north to south, and 1,500 miles from east to west, embracing the states of Alabama, North Carolina, South Carolina, Louisiana, Mississippi, Kansas, Oklahoma, Texas, Florida, Georgia, Arkansas, Tennessee, and Indian territory. Low-lying lands in the Mississippi valley, subject to periodical inundations (the "bottoms"), and the black soil areas of Texas and Alabama are the most productive areas.

India has manufactured cotton cloths of many kinds for many centuries. Perhaps, the most remarkable cloth is the sacred cloth made from the Gossypium Arboreum, a beautiful purple-blossomed cotton tree, which supplies the material for the sacerdotal three-parted thread of the Brahmin priests. Notwithstanding the antiquity of cotton in India, the fibre, which is mainly of the

"Upland" variety, is distinctly inferior to the American owing to lack of care in cultivation, the excessive heat, and the want of bright sunshine during the monsoon summer. The cotton region is about a quarter of the area of Great Britain; mainly on the Deccan, behind the Western Ghats, where the tenacious, rich volcanic soil wonderfully retains the often too slight rainfall. A considerable quantity is also grown under irrigation in the United Provinces, the Punjab, and Sind. In Egypt, cotton is cultivated in the delta and in those parts of middle Egypt where irrigation allows of moisture being supplied at intervals to the plant through the eight months required for its growth. The bulk of the world's fine cotton now comes from Egypt, and the yield per acre there is the highest known.

The by-products of cotton, when fully utilized, are calculated to increase the value of the cotton crop one-fourth. The seeds yield oil when pressed; the residue is made into cotton-oil cake, a valuable cattle food and a fertilizer; and the cotton stalks and leaves have a considerable value as forage, fuel, and fertilizer.

The chief cotton-producing areas are the United States, the predominant exporter, India, Egypt, China, Peru, Brazil, Mexico, Persia, Turkestan, West Africa, the West Indies, Uganda, and Japan. Some cotton is also grown in Korea, the Fiji Islands, Tahiti, Malta, Syria, Rhodesia, Venezuela, Paraguay, Queensland, Chile, Colombia, and Central America.

THE BRITISH COTTON GROWING ASSOCIATION. The shortage in the world's supplies of cotton, the increasing home consumption of the United States and India of their own growth, and the ever-growing demand for cotton, have led to the formation of the British Cotton Growing Association, which endeavours to promote the growth of cotton in all favourable regions of the Overseas Empire. Its labours have shown that the eastern and central Sudan can grow large quantities of cotton of the Egyptian type; that northern Nigeria, Rhodesia, Kenya, Nyasaland, Uganda, and Queensland can grow excellent "Upland" cottons; that the West Indies can produce superior "Sea Island" fibre; that many good native cottons can be developed into first-class quality cottons by careful cultivation; and that the Empire can become self-supporting.

Flax. The blue-flowered *flax* plant has a very wide range of climate, but thrives best in a stiff moist soil that has been fertilized for ages by the decayed leaf-fibre of deciduous forests, and is rich in phosphates. The plant yields two products—the fibre from which linen is manufactured, and the seed which yields linseed oil, used in the manufacture of paints and varnishes. Both products cannot be obtained in perfection from the same crop. The finest fibre is grown on the alluvial soils of Flanders, but Russia, normally, produces the major portion of the world's supply. Ireland, Latvia, Esthonia, central Europe, and northern Italy are other important producers of fibre. The crops of India, Argentina, and the United States yield rich seed, Cheap labour is essential in the cultivation of the plant and the manufacture of the products.

Hemp. This is a plant which yields a fibre similar to flax, but coarser and stronger. The fibre is manufactured into cordage, sailcloth, caulking material, and sacking ; the seed is used for poultry food ; and the oil is an important constituent of certain paints and varnishes. Russia and the Ukraine normally control the market for both fibre and seed ; but the best fibre comes from the Bologna district of Italy, and Hungary, China, India, and Japan grow large quantities. In "Monsoon" Asia various stimulants, such as hashish, are obtained from the plant.

Jute. Jute is a tropical plant, of the lime tree order, which grows to a height of from 5 to 10 ft. It requires rich alluvial soil, high temperature, and heavy rainfall. The delta of the Ganges, Ceylon, Formosa, Malaya, and China are the chief producing areas. Cordage, carpets, coarse gunny cloth, and sacking are the chief products manufactured from the fibre.

New Zealand Flax or Phormium. This is a plant of the lily family, indigenous to New Zealand. Its strong fibre, used for ropes and cordage, is derived from the long, narrow, spiky, iris-like leaves. It is becoming a valuable commodity now that an easy way of freeing the fibre of resin has been found.

Manila Hemp. This fibre is obtained from the leaf-sheaths or stem of a species of plantain, which is largely grown in the Philippines and the Moluccas. Its long, strong, tough, glistening fibres are used in the production of fine ropes, cordage, and ship's rigging.

Henequen or Sisal Hemp. Henequen is a very strong fibre obtained from the great sword-like leaves of Agave rigida, which is grown in Central America (Yucatan and Honduras), the Bahamas, Kenya, Nyasaland, India, the West Indies, Queensland, and Hawaii. It is used principally for sacking and twine.

Rhea, Ramie Fibre or China Grass. A species of stingless nettles, this grass is grown in Malaya, Further India, India, the West Indies, Kenya, China, Mexico, north Africa, and central Europe Its long, strong, lustrous fibre, which occurs under the outer covering of its stems, is difficult to obtain on account of the sticky gum which unites it to the bark It is used for cordage, coarse fabrics, and incandescent mantle fabric.

Aloes. These are produced in Barbados, Mauritius, and the Cape of Good Hope Province. The fibrous parts of the plants are used in the manufacture of cordage, and certain of the juices have medicinal properties. Other useful vegetable fibres are obtained from palm and pine trees. Thus, coir is got from the ubiquitous coco-nut palm, and vicua from the screw-pine.

Kapok. This is a fibre obtained from the seed capsule of Eriodendron aufractuosum, a Javanese tree. It is used chiefly in upholstery, in lifebelts, and in quilts.

Paper-making Fibres. These are largely of vegetable origin. The chief raw material, to-day, is wood pulp, derived from coniferous timber, especially spruce, although the esparto, Spanish or alfa grass of northern Africa and southern Spain, and the delta grass of Rumania are very important. Some other important materials are linen and cotton rags, wool (rarely), waste from the manufacture of linen and cotton, hemp, manila and jute refuse, straw, the bark of the paper mulberry (China), and seaweed (Japan). Norway, Sweden, Finland, Russia, Newfoundland, Canada, the United States, and Siberia produce most of the pulp wood. There is an increasing tendency to manufacture the paper itself wherever there is much available water power. Thus, the paper for the Amalgamated Press publications is made where the wood is grown and pulped in Newfoundland, using local water power.

(*i*) **VEGETABLE WAXES, GUMS, RESINS, DYES, AND VEGETABLE EXTRACTS.—Waxes.** The chief vegetable waxes of commerce, used in religious ceremonies, and in the manufacture of candles, furniture polishes, ointments, and in the finishing of certain fabrics, are : *bees' wax*, produced largely in central Europe, Italy, Canada, and California; *Japan wax*, derived from the seeds of certain trees of Japan, India, and China; *Brazilian wax*, found chiefly in the form of a glutinous powder on the leaves of the carnauba, or wax palm; *myrtle wax*, the product of a north American shrub, and the insect *white wax* of China. The *vegetable ivory* of commerce, largely used in making buttons, is the fruit of the stunted tagua palm, which grows wild along the west coast of South America from Panama to Peru.

Gums. *Rosin or resin*, used in making paper, soap, varnishes, and sealing wax, is the residue from the steam distillation of crude turpentine, which is obtained by making incisions into various coniferous trees in North America, Russia, Finland, France, Italy, and India. The United States is the chief exporter of both *oil of turpentine* and *resin*. *Gamboge*, used medicinally and in the preparation of the well-known water colour, is a special resin which exudes from a certain East Indian and Cambodian tree after tapping. *Eucalyptus gum or resin* is contained in the bark of the eucalyptus trees of Australia and the south-eastern parts of Malaya. *Amber*, used in making ornaments and expensive varnishes, is a fossil resin, found chiefly on the Baltic coast of Prussia, between the Frisches Haff and the Kurisches Haff. *Kauri gum* is a resin obtained from the Kauri pine of North Island, New Zealand, or from deposits in the districts formerly covered with kauri forests. *Gum arabic* is an exudation from thorny acacias growing in the scrublands of Upper Egypt and Arabia. *Gum senegal* is obtained from the scrublands north of the western Sahara. *Gum dammar* and *gum benzoin* come from Sumatra and south-eastern Asia; *dragon's blood*, a red resin, is obtained from the tropics of the Old World and the New; and *gum tragacanth* is exported from Asia Minor. *Mastix* is a product of the Island of Chios; and *frankincense* and *myrrh* belong to southern Arabia and India. *Assafœtida*, a gum imported as a tonic and anti-flatulent, is obtained from the roots of plants of a species of "ferula," growing in Afghanistan, the Punjab, and Persia. Russia and Sweden are the chief sources of supply for *wood-tar* and *pitch*, produced by burning coniferous timber in covered pits in such a manner that flames are excluded. *Gum copal* is derived from various trees growing in West Africa, East Africa, the East and West Indies, and South America. *Shellac*, the principal ingredient in sealing-wax, develops on certain Indian and East Indian trees, after attack by an insect. It is a kind of resin derived from the sap of the trees to which the insect attaches itself, but modified in its properties by passing through the body of the insect itself.

Dyes. Dyes have been used from time immemorial, and were till the middle of last century nearly all natural vegetable dyes. Since that time, *synthetic dyes*, produced chiefly from the coal-tar hydrocarbons, have come more and more into use, so that natural *indigo* and *logwood* are almost the only dyes used on a large scale which still compete with the synthetic product. The plant, from which the blue colouring matter called indigo is obtained, is a small shrub between 4 and 6 ft. high, a native of south-eastern Asia, but now successfully grown also in tropical Africa, tropical America, and even in the regions to the south-east of the Caspian Sea. The dye is obtained from all parts of the plant, which is cut down when flowering begins. The plants are well bruised with sticks, soaked in water in vats, and allowed to ferment for some time at about 85° F. When the oxidation is judged to be complete, the contents of the vats are allowed to settle, and bottom layers of semi-solid indigo-blue are obtained, which are pressed into cubes for the market. The woad of the Ancient Britons produced a blue dye almost identical with indigo. *Cutch*, or *catechu*, is a dry, brown substance obtained from the wood of the Acacia catechu in India and Burma. It produces on cotton a cheap and very good fast brown, but is more used for dyeing awnings. *Madder* was formerly grown in large quantities in southern Europe, France, and Holland, for the production of bright red (Turkey red) and yellow dyes. It has been largely superseded by artificial *alizarin*. *Logwood* is the heart-wood of Haematoxylon campeachianum, a tree growing abundantly throughout Central America and the West Indies. It is a heavy red wood, containing a yellow substance from which the colouring principle is subsequently obtained. The dye is cheap, and when used in dyeing cotton, wool, linen, silk, and leather, gives fast blues, browns, or blacks, according to the mordant used along with it. *Fustic* is obtained from the wood of Morus tinctoria, a species of mulberry tree growing in the West Indies, northern South America, and Central America. The yellow dye is used in conjunction with other dyes to give various shades of brown and orange. *Quercitron* is the inner bark of the Quercus tinctoria, or Dyer's oak, which grows abundantly in the forests of eastern Canada and the United States. The bark yields a yellow dye. *Brazil-wood* from South America, *Peach-wood* from Mexico, and *Sepan-wood* from the East Indies and Japan, all contain the dye called *brasilein*. They are used in the form of chips and raspings, to produce pinks and purples, and to compound with other colours. *Sandal-wood* from monsoon Asia and Madagascar, and *Bar-wood* from Sierra Leone, yield reddish and claret dyes for woollens which must be mordanted. *Annatto*, a yellow dye, much used for colouring milk, butter, and margarine, is derived from the fermented seeds of Bixa orellana of Central America. *Turmeric* is the ground rhizome of Curcuma tinctoria, which grows in monsoon Asia. It dyes yellow, brown, and orange, and is employed as an indicator in laboratory practice. *Persian berries* are the fruits of trees of the buckthorn genus (Rhamnus infectorius), which grow in the Near East and the Mediterranean countries. Aqueous, or alcoholic extracts, are used in dyeing to give yellows, oranges, and greens. *Orchil* is a red to yellow dye, formed by fermenting certain tropical and sub-tropical lichens, and *Cudbear* is similarly made from temperate lichens. *Blue litmus*, used as an indicator for detecting acidity in chemical practice, is prepared from Orchil. *Safflower*, a plant with large yellow flower-heads, from which a red and a yellow dye are obtained, is still grown in India. *Cochineal* is a female insect, which feeds on the sap of a species of cactus growing in Mexico, Honduras, Guatemala, Java, and the West Indies. After the males have flown away, the female insects are brushed off the plants into baskets, and either baked or boiled. The colouring matter, called *carmine*, is used in dyeing wool, and colouring sweets and foods.

Vegetable Extracts. Most tanning materials are products of the vegetable kingdom. Until comparatively recent years, the only inorganic tanning material used was common alum, but within the last 30 years *chromium salts* have come into regular use. Chromium salts produce leathers practically unaffected by hot or cold water, and when used in conjunction with organic tanning agents give leathers of great durability. Only the most important vegetable tanning materials are here mentioned. *Oak-bark*, the great tanning material of history, is probably the best of all the organic agents. *Valonia*, the acorn cup of certain east Mediterranean oak trees, is best for sole leather. *Hemlock-spruce-bark* and *larch-bark* are serious competitors of oak-bark in the United States and Canada. *Acacia-barks*—the black wattle of Australia and Natal bark—are used in the Southern Hemisphere and are also imported to the industrial countries of the Northern Hemisphere. Extracts made by boiling oak-wood, chestnut-wood, and hemlock-wood under pressure with water, are now very widely used for quick tanning. An extract known as *quebracho* is obtained from the hard red wood of a tree growing in Chile, Paraguay, and Argentina. It is rich in tannins and is now very widely used for the tanning of cheap leathers. *Cutch* extract, from India and Burma, is more used in dyeing than in tanning. *Gambier* is prepared as an extract from the leaves of a trailing shrub growing in Malaya, Java, Sumatra, and Borneo. It is used in the initial stages of tanning, and also in dyeing. *Sumach* is a greenish-yellow tanning material, consisting of the young twigs and leaves of a Sicilian shrub and several allied plants, very finely ground. Its cultivation has now spread into Tunis, Algeria, and South Africa. Sumach is principally used to tan morocco and similar light soft leathers. *Myrobalans*, the fruits of certain Indian plants, are good for soft leathers only when used in conjunction with other tannins. *Divi-divi* consists of the twisted pods of a South American leguminous tree. *Lentisk* is a very similar plant to sumach, but its extract is of inferior tanning value.

Rubber, India-rubber, or Caoutchouc. This is the latex of several species of tropical trees and plants. It is not a sap, and does not appear to take any part in the normal nourishment of the tissues of the tree. Usually, it is secreted in the inner bark, but may be present also in the roots and leaves. It is a tree emulsion, consisting of tiny globules of liquid rubber in suspension in a watery serum. Hevea brasiliensis, the species from which most rubber and that of the highest quality (Pará) is obtained, is indigenous to the regions of the River Amazon and the tributary areas of Peru, Bolivia, Ecuador, Colombia, and Venezuela, being especially vigorous and abundant on the plateau between the Tapajos and Madeira Rivers. Hevea is a large tree, of slow growth and long life, and requires low lying, rich, deep soil, and abundant moisture.

In the wild state the trees do not grow in clumps, but are scattered through the tropical forest. Manihot Glaziovii, like Hevea, a member of the spurge family, grows in the tropical region south of the Amazon, and furnishes Ceará rubber, poorer and less prolific than Pará. Its habitat is a high, stony, and arid country. Another Brazilian tree, the Hancornia speciosa, yielding Mangabeira rubber, exported chiefly from Pernambuco, grows in the provinces from Bahia to São Paulo. It flourishes best where there is a well-marked dry season, and even on sandy soil. The Castilloa elastica, or Ule rubber tree, produces heavy yields of inferior rubber, and while found in Peru and elsewhere, south of the Equator, its principal range is in Central America and south Mexico. Guayule (parthenium argentatum), a small shrub with greyish leaves growing as a weed in the desert lands of north Mexico, contains a pure rubber in its branches. In India, Assam rubber is obtained from a species of fig, Ficus elastica; in Borneo from a species of Willughteia; in many parts of Malaya from Urceola elastica; and, in Africa, Lagos rubber comes from Funtumia elastica, and African rubber of various species from twining plants belonging to the genus Landolphia. Tropical West Africa comes next to Brazil in the world's output of "wild" rubber, the valleys of the Niger and Congo being the chief producing areas.

Until recently, rubber has been obtained mainly from wild trees and vines in the wet equatorial forests of America, Africa, and Asia; but now the cultivation of rubber trees as a plantation product is becoming increasingly important. After a failure with Ceará rubber, Pará rubber trees proved very successful in Ceylon, the Malay Peninsula, Sumatra, Java, and, to a smaller extent, in India. The Ceará rubber tree is cultivated to some extent in eastern Africa, Brazil, and southern India, but plantations of Hevea trees in Africa have scarcely passed the experimental stage. "Wild" rubber in South America and Africa suffers from difficulties of labour and wasteful exploitation, whereas, in the Far East, the natives are an admirable source of labour. "Plantation" rubber demands much capital; is somewhat inferior to "wild" rubber (research may eventually lead to equal or better quality); and requires much labour and waiting for returns. Yet it can be placed on the market at prices equal to or less than those obtaining for "wild" rubber;

and the probability is that it will become the main source of rubber in the future.

There are different methods of collecting the rubber in the various areas. The guayule shrub is too small to be tapped, and the whole plant is carried to the mills, where it is torn to shreds, and then ground up finely with the help of flints and water. Rubber trees were treated in damaging ways in the past, even sometimes being cut down; but the general practice now is to make incisions in the bark with a very sharp instrument, which is so shaped that it does not cut too deeply. The cuts are either V-shaped, spiral, herring-bone or half herring-bone. The latex flows out into tin cups fastened beneath. A very small amount of bark is cut away each time, and the operation is usually renewed every other day over a period of about six weeks. When the whole of the bark, to a height of about 6 ft. from the ground, has been treated, the tree is allowed to rest for three or four years before being tapped again. The yield varies considerably, depending on the age and variety of the trees and vines; but the average is 3 to 4 lb. per tree. After collection, the latex is coagulated. On the Malay plantations this is done by adding a small quantity of acetic acid; but on the Amazon a sort of paddle is dipped into the latex, and held in the smoke of a fire fed with nuts of the urucuri palm. As soon as the first layer hardens the paddle is re-dipped and re-smoked, and this procedure continues until a lump of rubber, of from 20 to 100 lb. weight, is deposited in thin layers. Pure rubber, and rubber free from solid impurities, very soon "perish" in the air; and it was not until the discovery of vulcanization and the power of naphtha to dissolve rubber that the rubber industry really became important. The electrical and motor industries of the United States, the British Isles, Germany, and France have enormously stimulated the production of, and the demand for, rubber.

Gutta-percha. This is the coagulated juice of several trees of the Sapotaceae family, the chief being Dichopsis gutta. The trees are native in the Malay Peninsula, Java, and Sumatra; and in the wild state they are often felled and stripped of their bark, which is then beaten with mallets to extract the sap. Where the trees are cultivated they are tapped similarly to rubber. It is exported chiefly from Singapore, and finds its chief use as an insulator.

Balata, used as a substitute for gutta-percha, is the sap of a savanna tree which grows in the Guianas and Jamaica. *Chicle* is the sap of the Achras sapote tree of Mexico and Central America. It is practically all exported to the United States and Canada, where it is made into chewing gum.

(*j*) **TIMBER.**—Wood has been used by man since the very earliest times, and its constantly increasing use for constructional purposes, wood-paving, pulping, and artificial silk causes an enormous international trade in spite of its bulk and consequent heavy transit charges. The difficulty of transport is met in some degree by manufacture at the source. Thus, Sweden exports doors and frames rather than logs ; and Newfoundland, paper rather than pulp. The present great demand for timber, and the wasteful exploitation of forests in the past, have greatly increased the price of timber, and compelled most timber-producing countries to adopt scientific afforestation. In sparsely populated lands where there are great forests, timber can be exported profitably on a large scale only when there are easy means of bringing it to seaports. Scientific forestry has come too late for the present generation, and so some of the remoter forests have come into the area of commerce. Already the vast forests of the Pechora basin, east of the White Sea, and those on Russia's Pacific seaboard are being cut. The forests of Russia's interior, however, are still safe in their isolation.

The distribution of timber is essentially climatic, and each of the different vegetation regions of the world yields its own particular type. The bulk of the timber used, however, is from the conifers, which grow rapidly, branch little, and are soft enough to be easily worked. They have also resin which assists in the preservation of the wood, are markedly social in habit, and are usually situated where they can be exploited over snow. Russia, Canada, and the United States contain the bulk of the world's coniferous timber, and they, with Norway, Finland, Sweden, Austria, and Hungary, are the chief exporters. Most of the timber is exported in the form of logs, deals, deal ends, planks, and boards.

Difficulties of transport and labour, and the non-social habits of the trees, restrict largely the utilization of tropical timbers. Several hard woods, however, often beautifully coloured, close-grained, graceful, and capable of taking a uniform stain, are much in demand for furniture; and others are needed for the trade called coach-building, and for paving and harbour works. *Mahogany*, the best cabinet-making timber, is the wood of Swietina mahagoni, a large tree belonging to tropical America. The quality of the timber varies according to the locality from which it is derived, that from Mexico (Tobasco) and Hayti being regarded as the best. Inferior kinds come from Cuba, Jamaica, British Honduras, and West Africa. *Teak*, probably the most valuable of all timbers, is a monsoon product, growing in the forests of north India, Burma, Siam, and Malaya. Its hard and durable nature, and its little tendency to "rust," even when continuously exposed to moisture, make it very suitable for shipbuilding, harbour works, and construction work generally. Rangoon is the chief port of shipment. *Ebony* is a tree furnishing white-sap wood and black-heart wood, which grows chiefly in equatorial West Africa and India. The black-heart wood alone is exported, and is used for inlaying and walking sticks. *Rosewood* is a cabinet-making timber, derived from several Brazilian trees. It is used for the best quality tables and piano cases. *Green-heart*, or *bebeeru*, a tree growing in northern South America (especially in the Guianas) and Central America, yields a very hard, durable timber, excellent for shipbuilding and for piles.

Several important timber trees grow in the warm temperate regions, both those of the western or Mediterranean type and those of the eastern or dry winter type. *Walnut* and *American black walnut* grow in Eurasia and North America respectively. They both furnish a fine dark-coloured cabinet-making wood. *Box* is a Eurasian tree of slow growth and small size, yielding a very close-grained, hard wood, used for turning, rulers, and protractors. The *cork oak* is grown in Spain, Corsica, and on the western slopes of the Atlas mountains. The term *cedar* is applied to a number of trees whose wood is thought to resemble, in colour or appearance or both, that of the once famous cedar of Lebanon. White cedars of the forests on the lower Himalayas in north-west India are used for cabinet-making; and the red cedars, used in making pencils, come from the West Indies and Central America. The *Longleaf pine* of Louisiana, Florida, and South Carolina, the pitch-pine of European commerce, is the hardest of all coniferous timbers, and is used for the heaviest constructional work and for block-flooring. The

Californian *red-wood* and the Douglas *fir* of Oregon and British Columbia, which sometimes attain a height of 300 ft., are used for constructional purposes and for ships' masts. Australian timbers are intensely hard, but of little use for cabinet purposes. The *red-wood* of the Jarrah and the Karri of West Australia, two species of eucalyptus, is used for wood-paving and for the building of piers. In New Zealand, the kauri pine gives a yellow wood, very suitable for cabinet-making and the best exposed joiners' work.

The cool-temperate and transitional lands have two types of forest—the coniferous and the deciduous. The former supplies soft woods, such as the *white pine*, *hemlock*, *spruce*, *larch*, *birch*, and *Scotch pine*; the latter hard woods, such as the *oak*, *elm*, *beech*, and *ash*. A vast lumbering industry is carried on in Scandinavia, Russia, Canada, the Lake States of the United States, and central Europe, and will develop eventually in south-western South America. Yellow deal, or Baltic red-wood, is the wood of the Scotch fir. It is exported from all northern European countries, except Denmark, and is largely used in house construction. Spruce, silver fir, and larch, less valuable than yellow deal, are exported from the same countries. Hemlock, from south-eastern Canada and north-eastern United States, is a very important timber tree, yielding wood for house construction and pulp, and bark for tanning purposes. *Oak* was formerly used for all kinds of constructional work, but it is now largely limited to cabinet-making and panelling. It is exported from the Baltic, the Adriatic, the United States, and Australia.

ANIMAL PRODUCTS. (*a*) **Fibres.** WOOL. The most important of all animal fibres, wool is distinguished from ordinary hair by two important properties. First, while a hair is almost quite smooth on the outside, each fibre in wool is covered with minute overlapping scales, the edges of which are turned in one direction like shingles on a roof. These imbrications are exceedingly minute; merino, the finest wool, shows 2,800 to the inch of fibre; Southdown wool, 2,200. When the natural grease is scoured from the wool, the scales catch each other and hold the wool together as a tangled mass. This quality is utilized in making a matted, threadless fabric called felt, produced by beating, shaking, and rolling the fibres together. Secondly, each fibre of wool is finely crimped or curled and can be drawn out to greater length, returning to its original length when the strain is removed. Woollen fabrics are distinguished from fabrics made from cotton, linen, or other fibres by this elasticity. Most of the wool of commerce is obtained from the domestic sheep, which, by long breeding and selection, has come to have its chief coat of wool, although the animal also has some hair, and in some hot countries hair only. Wool varies greatly in different countries owing to variety in breed of sheep and in climatic influences. Several different species of wild sheep, such as the mouflon, and those of central Asia, produce considerable quantities of winter wool, but fail to yield the well-known woolly fleece of the domestic animal. For the finest wool, sheep require a dry temperate climate tending to warmth, and hence the " Mediterranean " grassy regions are peculiarly favourable. The merino sheep, subordinated to the production of the finest wool, is woolled so closely that there are from 40,000 to 48,000 fibres per square inch of skin. A native of Africa, it was introduced into Spain about the middle of the fourteenth century, and there greatly improved. Afterwards it was acclimatized, and still further improved in Saxony, and eventually transferred to the United States, Australia, South Africa, and Argentina with marked success. The best merino wool is now very long in staple, dense and soft in the fleece, with strong, fine, curly fibres, notably the Australian, and quite unlike the original type, though much short stapled merino wool is still on the market.

England was for a long period one of the most important wool producing regions, and raw wool, chiefly long-stapled Leicester and Lincoln, was her most important export. She still maintains a high standard of quality, and her wools are in much demand ; but the centres of wool production have shifted to the Southern Hemisphere, where land and labour difficulties are more easily overcome. The invention of cold storage in recent years has led to the breeding of cross-breeds, crosses between merinos and Lincolns, for the purpose of obtaining sheep giving plenty of good mutton and moderately good wool, in the wetter parts of Australia, New Zealand, Argentina, and South Africa.

Natural wool contains a high percentage of grease, and so, to lessen transport charges, the wool is sometimes scoured before being sent away. Scoured wool, however, does not travel so well as wool "in the grease," and does not fetch so high a price on the London market; therefore, unscoured wool is mainly exported. The chief wool-producing countries are: Australia (77,000,000 sheep, many of the merino type), Argentina (32,000,000 sheep, merino and cross-breed wool), Uruguay (17,000,000 sheep, similar to Argentina), New Zealand (24,000,000 sheep, cross-breed wool), the United States (39,000,000 sheep, inferior quality wool), Russia (probably 50,000,000 sheep, inferior wool), Turkish Asia (probably 40,000,000 sheep, inferior wool), South Africa (30,000,000 sheep, merino wool), and the British Isles (27,000,000 sheep, long-stapled and intermediate wools). Australia produces over 25 per cent and the British Isles about 4 per cent of the world's production of wool. The chief exporting countries are Australia, New Zealand, Argentina, South Africa, and India. Great Britain receives most of her supply from her colonies. River Plate wool finds its chief market in France, Belgium, and Germany.

The principal animals besides the sheep, yielding materials for the woollen manufactures, are the goat, alpaca, vicuña, and camel. Their fibres contain less imbrications than wool, but mohair, vicuña and alpaca fibres have high commercial value. The plateau steppes of Asia Minor are the native home of the Angora goat, which yields the mohair of commerce, highly-prized for its length, fineness, and silky appearance. It has been introduced into South Africa, and the mohair of the Cape of Good Hope Province is now a regular and important export. The Kashmir goat, of the upland valleys and enclosed plateaux of the Karakorum and north-west Himalayas, furnishes the bulk of the wool from which the famous Kashmir shawls are made. The material used is the fine downy under-covering which grows in winter. The domesticated alpaca and the wild vicuña, natives of the lofty Andean plateaux, belong to a remote branch of the camel family. The alpaca is confined principally to Peru and Bolivia, and yields a wool from 2 to 6 in. long—white, black, or grey, with sometimes shades of brown or fawn, lustrous and of fine quality. The difficulties of its manufacture were overcome by Sir Titus Salt, the founder of Saltaire. More valuable than alpaca is the fine, reddish-yellow wool of the vicuña of the high cordilleras, the supply of which is small. Camel's hair is now employed in the manufacture of coarse shawls, carpets, and various other fabrics, as well as for making painters' brushes.

SILK. The natural supply of silk depends almost entirely upon the instinct of a very inconspicuous moth (Bombyx mori) to provide for itself a snug case in which its metamorphosis into its perfect form may be effected. The silkworm has in its body the substance that becomes the silk fibre. It exists in the form of two jelly-like masses, which harden on exposure to the air. When the worm is about to pass into the chrysalis stage, it sends out this substance by two minute openings at its head, and the two streams uniting form an extremely fine thread, which the worm coils round itself, thus forming a cocoon. From the cocoons the silk is directly obtained; but as the thread of a single cocoon is much too fine for use in spinning and weaving, the threads of several cocoons are reeled together. After being reeled off from the cocoons, the silk is made up into hanks, and, in this condition, forms the raw silk of commerce. The outer husks of the cocoon and a part of the silk in the interior, both incapable of being reeled off, and the numerous fragments of thread which remain as refuse after the process of reeling, are exported as husks, knubs, and waste. Such material is now largely employed in the silk manufactures of Britain.

Since the leaves of various mulberry trees form the principal food of the silkworm, the animal is reared in all climates in which these trees thrive. Silk production, however, is largely restricted to those lands which have an average temperature of 55° F. for about three months, as this secures a second crop of leaves, and makes the worms more productive. Labour is another determining factor. The picking and cutting up of the leaves, and the handling of the cocoons, require delicate fingers, patience, and assiduous carefulness. Cheapness and delicacy of touch are secured by the labour of women and children. The light and valuable nature of silk makes transport charges of little significance, so that its production at a distance from water transport is practicable. Of the many varieties of mulberry trees the chief are the white mulberry of China the black mulberry of Italy, and the mulberry of India. It is necessary to note that silk is naturally produced in a continuous thread some hundreds of yards in length, and that, in proportion to its size, this extremely fine, glossy thread, which is about the three-thousandth part of an inch in thickness, is of extraordinary strength. Silks from other larvæ besides those of the silkworm are used in commerce, especially from the *Taser* of India, which feeds on twenty-five different kinds of trees; the *Eri* of Assam, which feeds on the castor-oil plant; and the *Antheraea peanyi* of China, which feeds on oak leaves. In commerce, these silks are known as Tussah or Tussore, but this name is also given to the waste of other silk after reeling.

The Far East monsoon countries, especially China and Japan, the original home of silk, lead in the production of silk, followed by Italy, Turkey, France, the United States, Syria, and Persia. The chief silk importing and silk manufacturing countries of the west are Italy, France, and the United States.

(*b*) **Animals and Foodstuffs of Animal Origin.** CATTLE. Cattle are bred mainly for either milk or meat, though in India they are used chiefly for draught purposes. When kept for meat they are usually associated with the sparsely populated newer lands, which have abundant natural pastures; while the older, more densely populated, and often wetter lands specialize in dairy cattle. The great cattle countries of the world are: India (120,000,000, chiefly for draught purposes and hides), the United States (60,000,000, chiefly for meat, but dairying is important in the north-east), Russia (probably 50,000,000, chiefly for hides, bones, and tallow), Argentina (29,000,000, chiefly for meat), Germany (20,000,000, both for meat and milk), France (14,000,000, both for meat and milk), and the British Isles (12,000,000, both for meat and milk). Live cattle are exported from the United States, Canada, Denmark, and Holland to the British Isles; and beef, fresh, chilled, frozen, and canned, is exported from the United States, Argentina, Uruguay, Canada, Holland, Australia, and New Zealand, to the industrial regions of north-west Europe. The great exporters of butter are Denmark, Holland, Finland, Sweden, New Zealand, Siberia (normally), Australia, Canada, and France. Cheese for export is made in Canada, Holland, Switzerland, France, and Italy. Horns, bones, hoofs, and hides, the by-products of cattle-ranching and meat production, come largely from India, Argentina, and Brazil. Condensed milk and dried milk are exported from Switzerland, the United States, and Australia.

SHEEP. Mutton, tallow, and sheep-skins contribute a very important share to the wealth of sheep-rearing countries. Excellent frozen mutton is exported from New Zealand, Australia (east and south-east coastal districts), Argentina, and Uruguay. Tallow and sheep-skins are exported from all the mutton-producing regions, and, in addition, they come from the Falkland Islands, South Africa, and central Asia.

PIGS. Pigs are reared in all non-arctic countries except those with a Mohammedan population. They are naturally forest animals, feeding on the acorns and beech mast in oak and beech forests. In Yugo-Slavia and Russia, lean pigs are still found under such conditions. Most pigs are, however, bred in maize-producing countries, especially the United States, and in the dairy-farming countries, where the best types are found. The leading countries are the United States, Germany, Austria, Hungary, Russia, France, China, Canada, South Africa, Argentina, Rumania, Yugo-Slavia, Denmark, Ireland, and Great Britain. Pork, bacon, hams, lard, and bristles are the chief products obtained.

HORSES. Horses are bred mainly for draught purposes, but in some parts of Europe horse-flesh is eaten. Their hides, hoofs, and hair have considerable value for leather, glue, and upholstery. All civilized lands breed horses, but the largest numbers are found in the United States, Russia, Argentina, Venezuela, Brazil, New South Wales, Hungary, and north Africa.

POULTRY AND EGGS. Poultry—fowls, ducks, geese and turkeys—are most favourably reared in grain-producing countries. Turkeys are reared chiefly in the United States, Canada, Italy, France, Ireland, and England ; geese in all northern countries ; and ducks and fowls in most countries. Cold storage enables large quantities of poultry to be exported to the industrial lands. Eggs are a commodity in enormous demand all over the world, but especially in western Europe. Waxed, dried, and fresh eggs are exported from the United States, Egypt, Morocco, China, Russia (normally), Denmark, Canada, Italy, France, Ireland, Holland, Italy, Yugo-Slavia, Poland, and South Africa.

RABBITS. Rabbits are bred tame in Belgium, but the great bulk of those on the market are the wild rabbits of Australasia, where they have become a plague.

FEATHERS. Feathers, used for stuffing beds and quilts, come from Greenland, Iceland, Norway, France, China, Hong-Kong, and the United States. The softest down feathers are supplied by the eider duck, which is plentiful on the eastern and northern sections of the Labrador coast ; on the cliffs of northern Scotland, Novaya Zemlya, the Faröe Islands, Spitzbergen, Norway, and Iceland. Ornamental feathers are exported from France, Holland, South Africa (ostrich), and the East Indies.

IVORY. The dentine or tooth-substance forming the tusks of the elephant and the hippopotamus is chiefly obtained from the tropical swamps and forests of Africa and monsoon Asia. A small supply of ivory is still got from the remains of the Siberian mammoth.

HIDES AND SKINS. The hides of cattle and horses and the skins of sheep, goats, and pigs, together with small supplies of the skins of the kid, crocodile, chamois, reindeer, dog, and whale, are the chief source of the raw materials of leather. The great sources of hides are the stockyards of the world, and much leather is made on or near them, notably in the United States. Australasian hides and skins are exported ready tanned. South Africa, India, and South America export mainly the hides of cattle and sheep skins. Goat skins come from the arid and semi-arid tracts of India, China, Italy, North Africa, and South Africa. Russia, Italy, and Canada have, in recent years, become important exporters.

CHAPTER VI

THE MAJOR ECONOMIC REGIONS OF THE WORLD

" In studying the geography of the world, it is better to consider the well-marked natural regions which do not change, rather than the political divisions which do."—*A. J. Herbertson.*

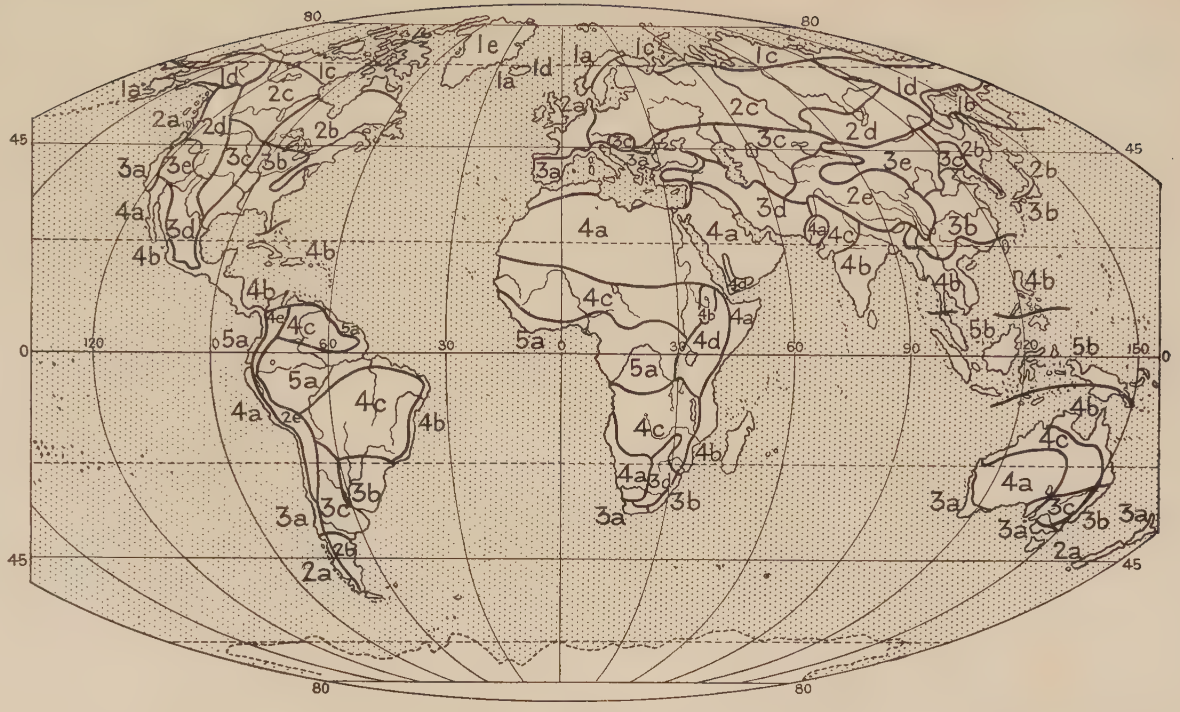
SCIENTIFIC geographical knowledge is not, as yet, sufficiently advanced for a division of the world into groups of regions to be made, which will show the members of each group closely approximating to each other in physical conditions—position, relief, structure, climate, and natural vegetation—and in the cumulative effect of these factors on the activities, thoughts, and physique of man. The world, however, must be visualized as a single organism, in which all the members perform their own peculiar functions, and act and react on one another. Divisions of the world into natural regions have been made, notably by the late Professor Herbertson, based largely on physical factors ; and though the human factors may differ in regions physically similar, owing possibly to human migration and heredity, these natural regions, when studied in conjunction with political factors and with the recognition that there are not only similarities but contrasts, provide the best basis of study. The natural regions here considered are the classification made by Herbertson. His natural region is a large portion of the earth's surface over which the physical conditions are sufficiently uniform to allow the area to be considered as a unit. Natural regions are not divided one from another by defined lines, but merge one into another.

1. POLAR TYPES—

1*a*. **Norway, highland type.**—In Europe : Norway, excepting the south-west. South-western Iceland. In North America : western Alaska.

1*b*. **Kamchatka, highland type.**—In Asia : Kamchatka and adjacent coasts.

1*c*. **Tundra, lowland type.**—The tundra tracts and barren lands in northern Eurasia and America.



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NATURAL REGIONS OF THE WORLD. (*Herbertson*)

1*d*. **Yukon, highland type.**—In Europe: northern and eastern Iceland. In Asia: north-eastern Siberia. In North America: Yukon basin.

1*e*. **Greenland, highland type.**—Greenland and other Arctic islands; Antarctica.

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Barrow Point (Alaska)	Sea-level	– 19° F.	38° F.	8 in.	Most in summer
Upernivik (Greenland)	Sea-level	– 8° F.	42° F.	9 in.	
Nain (Labrador)	Sea-level	– 7° F.	47° F.	19 in.	

The desolate tundras (Russian—marshy plains) stretch right round the margin of the Arctic Ocean. They are Regions of Privation, unconquered by man, where life is a perpetual struggle. The year consists of two seasons—a very severe winter of approximately eight months, with little or no daylight, and a summer of rarely more than four months, with almost continuous weak daylight. Winds are terrible in their severity. During the long winter darkness they howl for days on end, and are piercingly cold, and so dry that the breath fails to condense as it leaves the nostrils. Water is precipitated very scantily, chiefly in the form of snow, hail, and fog. For over two-thirds of the year vast regions lie buried under snow; and other regions, deprived of their snow mantle, are exposed to the full fury of the icy gales. Even in summer the surface soil thaws for only a few inches, and below this waterlogged layer the ground remains permanently frozen. Few plants can endure the harsh conditions. Ferns, mosses, lichens, dwarf birches, willows, junipers, stunted berry-bearing bushes such as the cranberry, crowberry, and whortleberry, and wondrously beautiful Arctic herbaceous flowering plants, make up the scanty vegetation. In the extreme north, plant-life, except the microscopic, disappears; but towards the south it is enriched, passing imperceptibly into woodland, in which the trees gradually increase in height, number, and variety.

Animals are fairly abundant in the tundras in summer, and many provide food, covering, and clothing for the sparse human population.

Reindeer in Eurasia, musk-ox and caribou in North America, polar bear, walrus, polar hare, lemming, Arctic fox, and numerous migratory birds which feed on the innumerable insects of the many bogs, are chief among the fauna. The abundant vegetation of the sea and its numerous floating minute animal life furnish food for seals and fish, themselves the prey of man, polar bear, and sea-birds. Human life is necessarily nomadic, and hunting and fishing are the primary occupations. The Eskimos, Aleuts, and other coast nomads of North America derive their sustenance almost wholly from the sea ; and follow the seals, bears, and gulls which come and go as they choose. During the summer they live in crude little tents made of skins, which are supported in the centre on sticks of precious driftwood or on the large bones of sea animals. At the approach of their long winter they halt and construct their igloos, or permanent winter dwellings of ice and snow, stone, sod, and skin. Their clothing is made of furs and bird skins ; their implements are of bone or driftwood ; and their food is almost exclusively animal, and mostly fat. Food must be stored in summer to last for the remainder of the year, and should the store be insufficient, winter migration is necessary to eke out the supply. Their only domestic animal is the dog, which draws the sledge and assists in hunting. More important than the dog for transportation purposes is the kayak, or boat, skilfully made from sealskins, bones, and driftwood. Simple and primitive, peaceable, poverty-stricken, and ever struggling, few races are more clever than the Eskimos in making the most of nature's scanty resources.

Scanty Indian tribes on the barren lands, and Lapps, Finns, Ostyaks, Yuraks, Samoyads, Yakuts, and Tunguses on the Eurasian tundras, depend on domesticated, semi-domesticated, and wild animals, and the berries and roots of the sparse vegetation. To Eurasian tribes the reindeer is of prime importance. It draws their sledges, and supplies flesh and rich milk for food, bones and horns for implements, and skins for shelter and clothing. Reindeer moss, which the animal reaches by digging away the snow, forms its winter pasturage. Reindeer must wander in quest of food, and, hence their parasitic owners must be nomadic. Berry-seeking, hunting for furs and game, and fishing accentuate the nomadic existence. The summer life is one of constant wandering ; the winter is under more settled conditions, usually on the southern tundra edge, though migration to fresh feeding-grounds is often necessary.

Tundra conditions are also found on most of the higher mountains of temperate latitudes, and on the highest mountains of the tropics. At greater heights the ice-cap type prevails. Greenland and Antarctica, lofty polar highlands, exhibit the most desolate conditions. Except for the narrow coastal strip of Greenland, these regions are buried under sheets of ice of unknown thickness. They are Arctic and Antarctic Saharas, almost devoid of life except on their margins.

On the Norwegian coast, and in Iceland, Labrador, and coastal Greenland there are settled, civilized, trading populations. Hammerfest, in north Norway, is a typical Arctic trading centre. Its trade depends almost wholly upon the sea, and is confined chiefly to the summer months. Salt, fish, cod-liver oil, eider-down, and reindeer and fox skins are its main exports. The interior of Iceland is elevated, and in part covered with snowfields and great glaciers. The population is, therefore, confined to the margins and the lower parts of the river valleys, and the only large centre is Reykjavik (15,000). Most of the inhabitants live in lonely scattered farms, on the margin of the fiords, or on the banks of the rivers. Sheep-rearing and fishing, with some spinning and weaving, are the principal occupations. The leading exports are fish (dried, salted or packed in ice), fish products (oil and roe), sheep, ponies, wool, tallow, hides, salted meat, and eider-down. Timber and wooden goods stand first on the list of imports, followed by cereals, coal, textiles, salt, colonial wares, yarn, and rope. The habitable coastal margin of Greenland is occupied mainly by Eskimos, but the trade is a monopoly of the Danish Government. There are some sixty trading settlements, each under a government official, to which the Eskimos bring the products obtained from their hunting and fishing activities. The most valuable article of commerce is, however, cryolite, a very rare mineral used in connexion with the production of aluminium, which is obtained from mines at Ivigtut. Mining for gold is also carried on under Arctic or semi-Arctic conditions in Alaska and the Yukon territory, and ores of the precious and common metals exist over wide areas, but are not, as yet, much utilized. Rich deposits of iron ore are worked in northern

Sweden, near Gellivara, and at Kirunavara and Luossavara, and copper ores at Sulitelma in Norway.

2. COOL TEMPERATE TYPES—

2*a*. **Western margin, or west European type.**—In Europe: British Isles, south-western Scandinavia, Denmark, western Germany, Holland, Belgium, France (except Mediterranean slopes), northern Spain. In North and South America: Pacific seaboard (Canada and north-western States, southern Chile). In Australasia: Tasmania, New Zealand (excepting north).

2*b*. **Eastern margin, or St. Lawrence type.**—In Asia: Armenia, eastern Korea (Chosen), northern Japan. In North America: St. Lawrence basin (eastern Canada and Labrador, south of the tundras, east of the prairies), Newfoundland, the United States (north-east and higher Appalachian slopes). In South America: southern Argentina.

2*c*. **Interior lowlands, or Siberian type.**—In Eurasia: Central Lowlands, Poland, European Russia (excepting south) and western Siberia, with Alpine lands and parts of Germany and Sweden. In North America: northern prairie lands.

2*d*. **Interior highlands, or Altai type.**—In Asia: Altai and adjacent plateau lands. In North America: northern part of the western mountain region, in Canada (British Columbia) and the north-western States.

2*e*. **High plateaux, or Tibet type.**—In Asia: Tibet and adjacent mountain lands. In South America: Andean high plateaux and mountain lands in Peru, Bolivia, and Chile.

The West European Type.

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Vancouver (Brit. Columbia)	Sea-level	38° F.	60° F.	38 in.	Rain at all seasons, but usually most in winter
Valdivia (Chile)	50 ft.	61° F.	45° F.	106 in.	
Valentia (Ireland)	16 ft.	45° F.	58° F.	60 in.	
Bergen (Norway)	50 ft.	34° F.	58° F.	68 in.	
Corunna (North Spain)	90 ft.	48° F.	64° F.	65 in.	
Hobart (Tasmania)	165 ft.	62° F.	46° F.	24 in.	
Hokitika (South Island, N.Z.)	10 ft	60° F.	45° F.	119 in.	

All the regions in this group lie in the track of the prevailing westerly winds, and of cyclonic storms. They have an equable and temperate climate with rain at all seasons, and weather characterized by changes every few days. Physically and historically, they display great differences. The plains of Britain, northern France, Holland, and Belgium do not find their counterpart elsewhere; and western Europe has behind it a long human history, a story of human effort, energy, initiative, and ingenuity overcoming natural forces, and gaining largely world mastery. Europeans have profoundly modified their environment, while the other regions remain largely in their primitive condition. There is, however, a marked similarity in the configuration of British Columbia and western Scandinavia. Western Europe is a region of subdued features, large plains, and gentle uplands, cloudy skies and damp atmosphere, and hence its vegetation lacks variety. Originally covered with forest, little now remains in the virgin state. The bountiful alluvial plains, lush grass, and graceful wolds attracted eastern invaders, who gradually drained the swamps, and cleared the forests, and practised agriculture with great success. Green pastures and meadows with scattered trees and patches of forest are now the chief features of the landscape. Coniferous forests of pines, firs, larches, and hemlocks compose much of the vegetation of Scandinavia and of the higher highlands of central Europe; while the deciduous birch is found higher and farther north than the conifers. The westernmost coniferous forests are to be found on the line of the Venns, the Vosges, Jura, and western Alps, on the central plateau of France, and on the Pyrenees. Mixed deciduous forests, of which the beech and oak are the chief constituents, occupy the lowlands of central Europe and small portions of western Europe. The western ranges of British Columbia and the northwestern United States have furnished, for a long time, an abundant supply of timber, the yellow pine and the Douglas or red fir being considered the most valuable. In Australasia and southern Chile the deciduous forests are little utilized. The immense water-power resources of the mountain regions of the western margin will, doubtless, be used in the future.

The western European lands are favoured with a climate best suited to human energy, great mineral resources, excellent transportation systems, ideal position for trade, and people, largely of Nordic stock, initiators in industry and democratic government. Britain leads in commerce and colonization; France in romantic thought and artistic taste; and Germany in technical research. Agriculture is highly scientific, both in dairying and crop-growing, and manufactures and commerce have reached the greatest development yet known. Their natural resources, however, are gradually being used up, notably in Britain, and much raw material has to be imported. The future seems to lie in the human element becoming perfectly trained, technically and intellectually. The Australasian and American regions are in their early stages of development, and are given up largely to the extractive industries—lumbering, mining, fishing, and agriculture. All the lands of the western margin type may be described as Lands of Hope and Rich Reward to Effort.

The civilization of Western Europe profoundly proves that the material environment does not embrace all the moulding influences on man. In deep and subtle ways man is congruent and solidary with the earth; and, like all other living things, changes which take place in him are not lost, but are built into him as the foundation of future actions. "His past in its entirety is prolonged into his present, and abides there actual and acting."—*Bergson.* Man's legacy from the past comes to him in three different ways—from the heredity of his ancestral stock, the economic equipment, and the accumulated wisdom, sorrows, and hopes of past ages. The precious things in his treasure-house are his ideals, ideas, and imagery, which are subtly connected with traditions and social heritage. His social inheritance constitutes a dominant factor in his progress, and binds him to the by-gone days. Psychology rather than geography provides the key to the social evolution of Western European nations.

Eastern Margin, or St. Lawrence Type.

The chief climatic differences between the eastern and western margins of the cool-temperate lands are that in the former the winters are much colder, the summers slightly warmer, and the rainfall is not so abundant, and summer is normally the season of most rain. In the North Temperate Zone high pressures prevail over the land masses, and low pressures over the oceans in January, and the reverse conditions in July. Winds, therefore, tend to flow out from the land in winter, and to flow in from the sea in summer, thus accounting for the climatic differences. Eastern Canada may be compared with Amuria and Manchuria, except that the St. Lawrence basin is more developed, and more accessible. In both the Old World and the New the rivers and harbours are icebound in the winter, except on the southern margin, owing mainly to the cold offshore winds. The Amur Valley leads into the interior of Asia, which, however, is of much less importance than that of North America.

Coniferous forests cover much of eastern North America and eastern Asia, but deciduous types are found on the richer and deeper soils, either pure or interspersed among the conifers. In the cleared areas agriculture, dairying, and fruit-growing are carried on. Lumbering is important in North America, less so in eastern Siberia, where hunting tribes still wander. Fishing, mining, and mixed agriculture, together with some manufactures of wood, textile, and metal, are the occupations of the Canadians and Americans, who have made considerable use of the abundant water-power. Amuria, the Manchurian basin, and the Japan Sea region, are developing their agricultural, mineral, and fishing resources, and progress is relatively great in the two latter regions, where Japanese influence is strong.

Southern Argentina exhibits semi-desert and steppe features. Physically, it is a low plateau, undulating and broken, consisting of shingle, rubble, and gravel, clay and sand. In the north the climate is half desert, and winter colds and frosts and icy winds are

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Halifax (Nova Scotia)	120 ft.	22° F.	63° F.	55 in.	At all seasons, but usually most in summer
Montreal (Quebec)	185 ft.	13° F.	70° F.	39 in.	
Vladivostok (Russian Pacific coast)	60 ft.	– 7° F.	67° F.	15 in.	
Hakodate (Japan)	20 ft.	27° F.	70° F.	45 in.	

prominent features. Scattered bushes, many of the salt-bush type, with occasional coarse grasses, form the vegetation. South and west of the Patagonian semi-desert oceanic winds play over the land, bringing moisture and moderating the winter cold. Trees are practically absent, and the vegetation consists of heath moors, low evergreen bushes, and sparse grasses. In most parts agriculture is not possible without irrigation, and sheep-farming, more especially in the south, is the main occupation. The lands of the eastern margin demand greater efforts from man than those of the western margin, but the reward is often great, and they may be described as Hopeful Regions of Effort.

Interior Lowlands, or Siberian Type—

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Leningrad (European Russia)	20 ft.	17° F.	63° F.	17 in.	Rain at all seasons, but usually most in summer
Vienna (Austria)	650 ft.	29° F.	67° F.	23 in.	
Calgary (Alberta)	3,400 ft.	12° F.	60° F.	15 in.	
Winnipeg (Manitoba)	760 ft.	– 7° F.	66° F.	22 in.	
Edmonton (Alberta)	2,160 ft.	6° F.	62° F.	13·9 in.	
Barnaul (West Siberia)	475 ft.	– 2° F.	67° F.	12 in.	
Moscow (European Russia)	500 ft.	12° F.	66° F.	20 in.	
Archangel (European Russia)	50 ft.	7° F.	60° F.	14 in.	

Both in Eurasia and North America the interior consists of a vast lowland crossed by great rivers. The climate is extreme ("continental"), the winters being long and severe, the summers hot, the rainfall never heavy and chiefly in summer, and quite small towards the east of the region in Eurasia and the west of the corresponding region in North America. The zones of vegetation are clearly marked. South of the tundra stretches the poor sub-arctic woodland, which passes gradually into fine coniferous forests, known in Siberia as the taïga. Farther south the trees thin out and pass into grasslands, in which trees are rare. These grasslands, called prairies in North America and steppes in Asia, permit tree growth only where moisture in the subsoil is sufficient, and the surface soil is not too porous. Long the homes of pastoral nomadic tribes, deriving the necessities of life from their domesticated animals, the better-watered steppes and prairies are now the scene of extensive agricultural enterprises, especially of wheat-growing, or " wheat-mining " ; while the more arid parts, such as the eastern-margins of the Rockies, are used for stock-raising, except where irrigation assists agriculture as in the Bow River Valley.

The North American prairies are better developed and more accessible than the Siberian lands. In the Old World, the farmers, who have inherited the soil, practise primitive methods of husbandry; whereas, in the New, agriculture has been developed extensively by settlers, who have established themselves in the region for that special purpose, and use, as far as possible, the knowledge gained in, or imported from, the scientific agricultural lands. Beneath the soil of the northern prairies are great deposits of lignite, which may be used in the future as the basis of manufacturing industries. The western steppes of Eurasia are very productive, notably so on the fertile " black earth " of the Ukraine. Farming, here, is of a varied nature ; and coal and iron are gradually establishing industrial areas. The eastern steppes are handicapped by their remoteness from the more advanced parts of Europe, but considerable progress has been made since the construction of the Trans-Siberian Railway. No lands of the Siberian type are found in the Southern Hemisphere.

When the virgin soils of the grasslands become exhausted, scientific farming will be necessary, and this will lead to a greater density of population and more important commerce. The prairies, in certain sections, already give such indications. Efforts to gain the approximate climatic limits of food plants will eventually be crowned with success, and the interior lowlands will earn the name of Regions of Sustained Effort, hopeful and rich.

The Interior Highlands, or Altai Type.

The chief regions of the Altai type are found in the Cordillera of western North America and in the highlands of south-eastern Siberia. Elevation is the controlling factor, and climatic conditions vary in accordance with it and with the exposure to, or protection from, the moist or cold winds of the slopes and the valleys. The North American region lies much nearer the ocean than the Asiatic highlands, and, therefore, has the advantages of a less extreme climate and a heavier rainfall. In America, the wetter western slopes, and in Asia the wetter northern slopes have the greater forests; the leeward sides are drier and barer. Above the forest line come grasslands, followed by vegetation of the tundra type, which disappears at the snow line. Spruces, firs, douglasias, and tsugas reach their maximum of wealth and density on the seaward American slopes. Less profuse are the larches, spruces, Siberian firs, and stone pines of the Siberian forests.

The rich mineral wealth of the highlands is extensively exploited in North America, and to a slight extent in Siberia. Agriculture is limited to the valleys, and stock-rearing is little developed. Lumbering is important in North America, and hunting and trapping are pursued in both the eastern and western regions, forming still the chief resources in the Siberian area, as they used to be in the American. The population is scanty, and hindrances to communication are great. Industries are unimportant, and the considerable water-power is entirely undeveloped.

Altai regions are Regions of Difficulty, giving small reward to much labour. They export their children, treasure ancient customs and languages, and provide homes for weak races.

High Plateaux, or Tibet Type.

Tibet is a series of wide, lofty, flat plateaux, separated by long ridges, and enclosed by the loftiest and most formidable mountains of the world. Much of the country rises to an elevation exceeding two miles, and is covered with glaciers, snow-fields, glacial and

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Kamloops (Brit. Columbia)	1,200 ft.	25° F.	69° F.	11 in.	Rain at all seasons, but mostly in sum'r
Helena (Montana, U.S.A.)	4,150 ft.	20° F.	68° F.	13 in.	
Irkutsk (Siberia)	1,600 ft.	– 5° F.	65° F.	14 in.	

alluvial rubble, shingle, and gravel. The winters are long and severe; the summers are hot; and rain is almost absent. Trees and shrubs are rare, and most plants are dwarf and crawling. In the east and on the lower valley slopes there are tufted grass pastures for the shaggy yak, wild asses, and sheep; and towards the south, the more sheltered plains and valleys occasionally support orchards of fruit trees (peach and apricot), and cultivation of barley and pulses is possible under irrigation, especially round Lhassa. The north-western portion is a dry, cold desert, almost destitute of plant life.

The west coast of South America, from the Equator to south of the tropic of Capricorn, is bordered by the Andes, whose western and eastern Cordillera enclose the high plateaux of Peru and Bolivia (10,000—12,000 ft., with peaks above 20,000 ft.). According to the elevation the climate and vegetation vary from tropical to ice-cap. On the higher parts of the plateaux, the "punas," the climate is very extreme. The air is extremely dry; the meagre precipitation falls chiefly as snow during the winter in daily storms; and very great extremes of temperature, both annual and daily, occur. The soil is generally stony, pebbly, or sandy, sometimes permeated with salt, rarely fertilized, and nearly always parched. The vegetation, therefore, consists of a sparse dotting of grass tufts and other low plants. On these poor pastures lean cattle, llamas, alpacas, and wild vicuñas feed.

Both regions are rich in minerals, but mining is practically unknown in Tibet, and difficulties of labour and transport impede the mining of Bolivia and Peru, although they supply much of the tin, copper, and silver of the world. The punas and high plateaux of the Tibet type are regions of transit, largely uninhabited, and

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Leh (Kashmir, India)	11,500 ft.	19° F.	64° F.	1 in.	Rain at all seasons, but most in sum'r
Lhassa (Tibet)	11,900 ft.	27° F.	65° F.	15 in.	
La Paz (Bolivia)	12,100 ft.	52° F.	45° F.	21 in.	

are well described as Regions of Lasting Difficulty. Nothing of importance to the progress of man has yet come from Tibetan lands.

3. WARM TEMPERATE TYPES.

3a. **Western margin, or Mediterranean type.**—In Europe, Asia, and north Africa : Mediterranean coast lands, including Spain (greater part), with Portugal, France (part), Italy, Yugo-Slavia (Adriatic sea-board), Balkan countries, coast-lands of Asia Minor, Syria, and north Africa. In North and South America : Pacific sea-board (California, central Chile). In South Africa : South-western extremity (Cape of Good Hope). In Australasia : the south-west of Western Australia, the south of South Australia, northern New Zealand.

3b. **Eastern margin, or China type.**—In Asia: China, western Korea (Chosen), and southern Japan. In North America : United States, approximately Iowa, Missouri, Arkansas, eastern Texas, and east thereof to the Atlantic, including the Gulf coast. In South America: south-eastern Brazil, Uruguay. In Africa: south-eastern coast lands. In Australasia: sea-board of New South Wales and southern Queensland.

3c. **Interior Lowlands, or Turan type.**—In Eurasia: Turan, Trans-Caspian and Caspian districts ; Russian lands in south Europe, Danubian plains (Rumania, Hungary), Manchuria (part). In North America: west central States below the western mountain region. In South America: northern Argentina. In Australasia: interior parts of New South Wales, Victoria, South Australia (south).

3d. **Plateau, or Iran type.**—In Asia: Iran (interior of Asia Minor, Persia, Afghanistan, Baluchistan). In America: interior (arid) lands in the south-western States and Mexico. In South Africa: interior (veld) lands.

3e. **Plateau with cold winters, or Mongolian type.**—In Asia: Mongolia and adjacent lands. In the Northern Hemisphere the warm temperate lands stretch continuously across the New World. In the Old World they are interrupted by a wedge of the highest land in the world, and they cross South America in its tapering portion.

Western margin, or Mediterranean Type—

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
San Francisco (California)	60 ft.	50° F.	58° F.	24 in.	Wet winters; dry summ'rs
Valparaiso (Chile)	135 ft.	63° F.	53° F.	24 in.	
Palermo (Sicily)	220 ft.	51° F.	76° F.	30 in.	
Algiers (Algeria)	75 ft.	54° F.	77° F.	27 in.	
Valencia (Spain)	75 ft.	49° F.	75° F.	19 in.	
Cape Town (Cape of Good Hope)	38 ft.	70° F.	54° F.	25 in.	
Perth (West Australia)	47 ft.	76° F.	55° F.	33 in.	

The western margin or "Mediterranean" lands, lying on the western side of great land-masses and between latitudes 30° and 40°, have the wet westerlies in winter and the dry trade winds in summer, owing to the migration of the belts of pressure and the resulting winds. Hot, dry summers and mild, rainy winters are the climatic characteristics. The mean average temperature for the year ranges in most districts from 60° to 70° F. Snow and ice are not infrequent in midwinter. The rainfall is irregular, and varies from 20 to 40 in. The bulk of the rain falls during the short winter in heavy showers, and the dry summer is broken only by occasional storms. Thrifty, steady, slow, continuous growth characterizes the vegetation. Except during the two short spells of early spring and late autumn, no season is sufficiently favourable to encourage intensely active growth. Adaptation of plant-life to low temperatures when the rainfall is satisfactory, and to warmth in the period of drought, is attained by the small-leaved, leathery, dull ever-green or ever-grey foliage; the deep-striking roots; the development of thorns and prickles, resins, waxes, and essential oils; and the compact structure of trees, shrubs, and herbs. Where the rainfall is sufficient open forests of walnut, chestnut, ilex-oak, cork oak, stone-pine, aleppo and black pines, firs, cypress and cedar, occur. Natural pasture lands are rare, and rich succulent grasses are almost entirely absent. The driest areas present a semi-desert appearance.

Agriculture affords most varied resources, but irrigation is often necessary for summer crops. The sugar-cane, rice, cotton, maize, barley, and wheat grow well in irrigated areas. Luscious fruits attain perfection. Among them are olives, mulberries, grapes, oranges, lemons, figs, apricots, peaches, almonds, citrons, chestnuts, walnuts, carobs, and pomegranates. Olive oil takes the part that butter performs in cold temperate regions; the mulberry leaves feed the silk-worms; and the grapes give rise to wine production, raisins, and currants. Early flowers, fruits, and vegetables are produced for the northern markets. The mountains and plateaux are pastoral. Goats, asses, and sheep are naturally more numerous than cattle and horses, as they thrive under drier conditions and need less succulent food. Manufacturing industries are much less important than in the lands of north-western Europe. Coal is almost absent; mineral wealth, even when great, is only partially exploited; and labour largely lacks the skill, energy, and organizing ability of the northerners. Italy, alone, has made appreciable progress. Commerce early developed in the Eurasian "Mediterranean" lands, and the Mediterranean Sea has been for centuries one of the great traffic ways of the world. Through trade, "luxury" trade, and trade in necessities are a characteristic feature of the western marginal lands.

There has been a remarkable interchange of useful plants in the various regions. The olive tree is common to all, and wine is made and exported from all, except the Mohammedan lands and California. Australian eucalyptus trees have been planted in large numbers in Palestine; the prickly pear of California is common in southern Europe; and the sumach shrub of Sicily has been successfully introduced into South Africa. Fuller future development will, doubtless, lead to a greater similarity of products and human activities than is at present the case.

The Mediterranean lands are Regions of Increment, lands which allow leisure for thought, and often give rich reward to moderate effort. Through the pages of history, the Eurasian "Mediterranean" lands have played their part and have formed ideal homes for man. The fertility of the soil and clemency of the climate made life easy, yet did not foster sloth and idleness, and eastern and western thought easily met. Egypt, Rome, Greece, Babylonia, Syria, Crete, and Carthage developed great civilizations, which gave invaluable contributions to art, science, and government, and have powerfully influenced the history of mankind.

The Eastern Marginal Lands, or China Type—

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
New Orleans (Louisiana, U.S.)	52 ft.	55° F.	82° F.	60 in.	No season of drought. Most rain falls in spring & summer
Monte Video (Uruguay)	40 ft.	73° F.	52° F.	45 in.	
Durban (Natal)	250 ft.	77° F.	64° F.	42 in.	
Shanghai (China)	23 ft.	38° F.	82° F.	46 in.	
Tokio (Japan)	69 ft.	37° F.	78° F.	62 in.	
Sydney (New South Wales)	150 ft.	72° F.	52° F.	50 in.	

The eastern marginal lands receive summer rains. The climate is extreme in most of the regions, the summers being hot, and the winters often extremely cold. They cover the eastern portions of the continents on the polar sides of the tropics to about 40°, and are in the monsoonal rainy regions, north of the tropics in Asia, and in the normal trade wind rainy regions elsewhere. In southern Japan insular conditions bring in a fairly uniform rainfall throughout the year; and in the parts of Australia and south-east Africa which belong to this type, the winters are mild.

The combination of heat and rain in the summer season ensures a luxuriant vegetation. In the forests broad-leaved and southern coniferous types are found, many of which are valuable for their timber. Among the valuable trees are the yellow pines from the South Atlantic and Gulf States, the Georgian white pine, the Virginia cypress, the walnut, chestnut, beech, magnolia, sycamore, and oak. The undergrowth of evergreens of camellia and laurel types recalls the evergreen scrub of the "Mediterranean" lands. Agriculture, the all-important industry, has been practised by the Chinese for thousands of years. They show marvellous skill and exemplary patience in the cultivation of their small plots, and the influence of agriculture on their lives and thoughts is most marked. Noteworthy agricultural regions are the valleys of the Yangtse and Hwang-Ho, and the terraced region of Szechwan. Very important crops in the various regions are maize, wheat, millet, pulses, rice (the staple food of the Mongolian races), indigo, tobacco, cotton (most of the world's supply), camphor, tea, the opium poppy, hemp, ramie, banana, lemon, and orange. Population is very dense in the Asiatic lands, less so in the other lands. Consequently, domestic animals are few in the former lands, and more numerous in the latter lands. In all the regions the seaward parts are the best watered and the most productive.

Manufactures are best developed in the southern United States and Japan, which have made marked progress in recent years. China's great mineral wealth is only now beginning to be utilized, and industry is still in its infancy. Japan, confronted with overcrowding, and a land largely adverse to agriculture, has adopted western methods, and gained a high position in the world's industry and commerce, thus partially solving her difficulties. Many of the lands of the China type are Regions of Increment, but the drier areas demand patience and unremitting toil from their inhabitants.

The Interior Lowlands, or Turan Type—

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Cheyenne (Wyoming)	6,100 ft.	26° F.	68° F.	13 in.	Most rain falls in summer
Bismarck (North Dakota)	1,680 ft.	8° F.	70° F.	19 in.	
Cordoba (North'n Argentina)	1,450 ft.	73° F.	50° F.	28 in.	
Astrakhan (Russia)	50 ft.	19° F.	78° F.	6 in.	
Bourke (New South Wales)	450 ft.	84° F.	51° F.	17 in.	

Most of the lands of this type are lowlands, but exceptions occur in the case of the "high plains" east of the Rockies and the Andes. Nearly all from their position in the interior of great land-masses have extreme climates and scanty rainfall. Aridity is most pronounced in the Old World. According to the amount of the rainfall the lands are clothed with rich grasses, or with poor grass and thorny scrub, and are sometimes little better than desert.

The chief industry is the pasturing of cattle, sheep, horses, camels, and goats, once the occupation of nomadic tribes, who are now being steadily pushed towards the deserts and their margins. Most of the better-watered areas are devoted to the cultivation of maize, wheat, and barley ; and irrigation and " dry-farming " methods are increasing the agricultural areas. Where mountain streams or wells bring moisture to the fertile soil " Regions of Increment " are found, producing cereals, " Mediterranean " fruits, and cotton. Thus, the Turan oases of the valleys of the Amu and the Syr display luxuriant orchards and rich fields of grain. Climatic conditions were probably much more favourable in the past in the Asiatic Turan lands. It is difficult, otherwise, to explain the existence of the once powerful empires in Ferghana, Sogdiana, Bactria, and Wergian, and the successful waves of invasions made from these regions into more settled lands. Mining for silver, copper, and zinc is carried on in the North American and Australasian portions, but manufactures are almost non-existent.

The Plateau, or Iran Type—

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Salt Lake City (Utah, U.S.A.)	4,350 ft.	29° F.	76° F.	16 in.	Most rain falls in summer
Mexico City (Mexico)	7,474 ft.	54° F.	63° F.	23 in.	
Johannesburg (Transvaal)	6,300 ft.	68° F.	47° F.	31 in.	
Kimberley (Cape of Good Hope)	4,050 ft.	75° F.	48° F.	18 in.	
Bloemfontein (Orange Free St.)	4,550 ft.	75° F.	46° F.	23 in.	
Teheran (Persia)	3,800 ft.	34° F.	86° F.	10 in.	
Ispahan (Persia)	5,350 ft.	32° F.	82° F.	5 in.	

The climate of most of the Iran type of lands is extreme, especially in the North American and Asiatic regions. The rainfall is scanty, and largely confined to the summer months. Rich grassland is rare, and large portions of the land are poor grasslands, scrub, or actual desert. In South Africa the belt nearest the coastal scarps of the Drakensbergs has rain enough for permanent pasture, but westwards the vegetation passes from poor grasses, scrub, and semi-desert to the Kalahari arid wastes.

Agriculture is possible only on the richer lands of South Africa, or where mountain streams, oases, irrigation, or "dry-farming" methods lend aid. The chief agricultural products are cereals, "Mediterranean" fruits, cotton, tobacco, sugar-cane, beet, and roses (Persia). Iran is in the belt of lands which have been gradually drying up. Like Turan it had its powerful empires and sent out its waves of invaders. Its people were early devoted to agriculture, which they raised almost to a religion. On the plateau of Anahuac, the ancient Mexican Nahuas practised an intensive form of agriculture and gardening, superior to that known to the Spanish Conquistadores. Cattle, sheep, horses, and camels feed on the richer grasslands, and pastoral nomads migrate regularly with their flocks and herds from winter lowlands to summer highlands. Mineral wealth is hardly exploited, but is undoubtedly great, and manufactures are represented only by the domestic carpet industry.

Iran lands are largely Lands of Lasting Difficulty as regards climatic conditions and intercourse.

The Cold Plateau, or Mongolian Type—

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Urga (Mongolia)	3,800 ft.	15° F.	63° F.	8 in.	Most rain falls in summer
Kashgar (Sin-Kiang)	4,035 ft.	22° F.	80° F.	2 in.	

Mongolia is drier than the Asiatic Iran lands, and has cooler summers and much colder winters. It is mostly forbidding desert or scrubland, with a fringe of oases round the foot of the bordering mountains. Fertile orchards and cornfields are found on the oases, but nomadic life is elsewhere a stern necessity. Caravan routes pass through it from the populous and productive lowlands of China. There is no other exact parallel of this region in the world, though the Great Basin region of the United States shows some similar characteristics. Forbidding and isolated, Mongolia is a Region of Lasting Difficulty.

4 and 5. TYPES OF TROPICAL HOT LANDS.

4*a*. **Western desert, or Sahara type.**—Deserts of north Africa

(Sahara, Somaliland), Asia (Arabia and Syria, north-west India), North America (south-west), South America (central Pacific coast-lands in northern Chile and Peru), South Africa (Kalahari), Australasia (west-central Australia).

4*b*. **Monsoon type.**—In Asia: India (excepting north-west), Burma, Siam, Indo-China, southern China, Philippine Islands (Asiatic monsoon lands). In America: Central America, Caribbean sea-board (Colombia, Venezuela), West Indies, Brazilian sea-board (part). In Africa: Abyssinia (part), central East Africa coast-lands, Madagascar. In Australasia: Queensland and Northern Territory coast-lands; southern New Guinea.

4*c*. **Summer rain type of the Interior, or Sudan type.**—In Asia: north-west India (Punjab). In South America: Orinoco basin (except coast-lands), and southern interior of Brazil In Africa: Sudan, Upper Zambezi and Congo lands In Australia: interior lands marginal to desert (north and east).

4*d*. **Moderate plateau type of East Africa.**—In Africa: East African plateau. In Asia: highland of south-western Arabia (Yemen).

4*e*. **High plateau type of Ecuador, Colombia.**

5*a*. **Wet equatorial lowland, or Amazon type.**—In Africa: Congo basin and Guinea coast. In South America: Amazon basin in northern Brazil, and Guiana coast-lands.

5*b*. **Wet equatorial mountainous islands, or Malay type.**—In Asia: Malay peninsula (south), and greater part of the archipelago.

The West Tropical Deserts, or Sahara Type—

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Iquique (Chile)	30 ft.	71° F.	61° F.	0·2 in.	Deficient at all seasons
Aswan (Egypt)	360 ft.	60° F.	93° F.	—	
Walfish Bay (S.W. Africa)	10 ft.	66° F.	59° F.	0·3 in.	
Onslow (West Australia)	Sea-level	84° F.	64° F.	7 in.	
Alice Springs (Northern Terr.)	2,000 ft.	87° F.	52° F.	10 in.	

A band of rainless deserts is located round the tropics (broadly speaking, at about latitudes 20° to 30°), occurring on the western margins of every continent. They are in the track of the trade winds, which bring moisture to eastern margins, but on western margins are dry off-shore winds. The bare surface, rapidly heating and cooling, causes a great range of temperature between day and night, and between summer and winter.

The Sahara or North African desert, the world's largest desert, presents a very varied surface. It rises gradually to the south, and is traversed from north-west to south-east by a belt of plateau highlands. Sand-dunes or "ergs," vivid orange or delicate greyish-green in colour, and stony wastes, where camel and sheep find little or no pasture, make up much of its surface. In this land of thirst the eye only occasionally meets a tuft of grass, a half-buried tussock of apparently dead sticks, or a low thorny scrub. Scattered here and there, in shallow troughs and round springs, the oases break the monotonous surface. They are in the desert but not of it. Agricultural people, settled on the oases, grow the invaluable date-palm, vegetables, cereals, pulses, fig, orange, lemon, pomegranate, melon, and olive. On the desert margins, sheep, camels and goats are kept by wandering herdsmen. Camel caravans cross the desert by well-known routes from well to well, and from oasis to oasis, over and along the sandy and stony wastes, carrying gums, dates, and hides. For ages the Sahara barrier has separated Europe from Africa more effectually than the sea. It still remains unconquered ; caravans take several weeks to traverse it, and no railway has yet penetrated its heart. Egypt and Irak, scenes of early powerful agricultural civilizations, are narrow, long oases, irrigated and fertilized by the waters of the Nile, and the Euphrates-Tigris, respectively.

Beyond the Red Sea, the Arabian desert with its vast seas of moving sand and wastes of stone and lava, continues the Sahara. The valleys are cultivated under irrigation, but the interior has practically no vegetation. Comparable with it, though on a smaller scale, is the Indian desert. The North American desert consists of alkaline plains, remarkable for the extraordinary development of fleshy, thorny, leafless, or apparently leafless plants, called succulents. Yuccas, agaves, and great candelabra cerei display weird, ungainly, menacing shapes. Wandering Indian tribes find scanty sustenance; yet, in the past, the Papagos Indians developed a fairly advanced system of agriculture based on irrigation. The coastal Atacama desert of South America, perhaps the barest region of the tropical world, is a very important source of nitrates, which are extracted and shipped to the whole world. Human habitations are entirely confined to the coast, where water can be had by boring. The stony and sandy Kalahari desert, covered with poor grass and thorny scrub, is very sparsely occupied by the poorest type of African native tribes, driven there from the better regions around. Arid central Australia has neither caravan trade nor oasis settlements. In the barer parts it is sandy or stony and without vegetation; elsewhere, spinifex grass appears in solitary tufts and thorny acacias occasionally occur. Near its southern margin it is crossed by the Federal Transcontinental Railway, and there are stock routes from the northern savannas to the populated areas in the south-west and south-east. Gold deposits have established large settlements, as at Coolgardie and Kalgoorli, to which water is conveyed in pipes from the south-western margins. Elsewhere, nomadic aborigines lead a hard existence. Apart from the oases, the deserts are, and perhaps will ever be, Regions of Privation and Lasting Difficulty.

The Monsoon Type—

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Bombay (India)	35 ft.	74° F.	80° F.	79 in.	Mainly in summer
Calcutta (India)	20 ft.	65° F.	83° F.	78 in.	
Colombo (Ceylon)	24 in.	79° F.	81° F.	88 in.	
Port Darwin (Northern Terr.)	70 ft.	82° F.	75° F.	62 in.	
Mozambique (Port. E. Africa)	Sea-level	83° F.	74° F.	40 in.	
Rio de Janeiro (Brazil)	224 ft.	79° F.	70° F.	44 in.	
Belize (British Honduras)	Sea-level	75° F.	82° F.	81 in.	

The monsoon lands show great variations in relief and other features, which sometimes largely modify the climatic régime; but most are dominated by winds from sea to land in summer, the wet season, and by winds from land to sea in winter, the dry season. The strong rhythm of the two seasons is well displayed in India; though on the outskirts of the area, along the Malabar coast, in the north-eastern Himalayas, Assam, and western Burma, the drought is so short as to be practically without influence. In these regions, evergreen wet forests occur. Throughout the remainder of India, tree-growth contests with scrub for the mastery of the soil. Where tree-growth is possible, the forests are open, and display periodicity of growth and frequently deciduous types of trees.

Agriculture is the predominant occupation of the inhabitants of all the monsoon lands. It supports teeming millions in Asia, and the rich rewards to be gained by moderate human effort applied to the fertile soils of the many " Regions of Increment " have attracted and still attract invaders and immigrants. The cultivated products vary with the elevation, the rainfall, and the skill of the cultivator; but palms, bamboos, hardwoods, rice, maize, millet, sugar, and cotton are grown in nearly all the regions. Coffee, tea, cocoa, indigo, cinchona, tobacco, rubber, jute, oil-seeds, tropical and subtropical fruits, and pulses are other important crops. The purely pastoral industry is of little importance, but mining is developing in both the Asiatic, Australian, and American lands. Domestic manufactures in metal, wood, and fibre are remarkable for their artistry and infinite detail, the products of centuries of inherited skill and marvellous patience. Factory industries are now developing in the Asiatic lands. In the Australasian lands an interesting attempt is being made to develop the monsoonal tropical tracts by means of white labour only. As yet these regions are " empty," and their great potential resources are undeveloped except in the south-east. The Asiatic lands, in striking contrast, exhibit highly developed communities, with many arts and literatures, long evolutionary institutions, great cities, and wide commerce.

The Sudan Type.

The Sudan lands have heavy summer rainfall, with range of temperature varying with the elevation. Over most of the regions the rainfall is not sufficient to keep the ground moist at all seasons of the year, and, therefore, the vegetation is of the savanna type—

grass land, diversified with clumps of trees. Despite differences of detail in the various lands, the main savanna characteristics of tall grassland dotted with deciduous trees and bushes, either dispersed or in woods, are common to all.

On the drier savannas the main occupation is stock-rearing, which tends to become nomadic as the deserts are approached. The campos and pampas of the Plate basin, and the llanos of the Orinoco, to a lesser extent, provide much of the beef and mutton needed in north-western Europe. In the better-watered areas, plantations yield cotton, sugar, coffee, manioc, dhurra, bananas, pineapples, maize, wheat, and barley ; while from the hill-slopes, tea and timber are obtained. The great modern demand for cotton is causing considerable increase in cotton cultivation in the more favoured parts of the Sudan lands. Cultivation is now being developed in all the savanna regions under European influence, and there is good promise that they will rank eventually with the favoured monsoon lands as the most productive and populous lands in the tropics. They are lands which demand effort and thought for the future.

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Daly Waters (Northern Terr.)	700 ft.	85° F.	67° F.	28 in.	Mainly in summer
Kuka (Sudan)	870 ft.	71° F.	83° F.	20 in.	
Khartoum (Anglo-Egyptian Sudan)	1,259 ft.	70° F.	92° F.	15 in.	
Quixeramobim (Brazil)	700 ft.	83° F.	78° F.	23 in.	

The Moderate Plateau Type of East Africa—

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Tabora (Tanganyika Territory)	4,000 ft.	72° F.	70° F.	30 in.	Mainly in summer
Fort Smith (Kenya)	5,200 ft.	63° F.	58° F.	32 in.	

Lands of this type are higher, cooler, and often drier than the Sudan lands, and in the higher parts temperate crops can be raised. In Africa, these regions are being gradually occupied by Europeans, and, in Arabia, Yemen's wealth and diversity of natural and cultivated resources have earned for it the name of Arabia Felix.

The High Plateau or Ecuador Type—

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Quito (Ecuador)	9,350 ft.	54° F.	55° F.	44 in.	At all seasons, Double max'm
Bogota (Colombia)	8,725 ft.	58° F.	57° F.	63 in.	

The high plateau type in Ecuador and Colombia is found above 9,000 or 10,000 ft. The climatic characteristics are of comparatively low seasonal range owing to low latitude, but a considerable general lowering of temperature owing to altitude. There is usually a considerable difference between the day and night temperatures, and even at Quito, almost on the equator, the evenings are frequently very cold.

Few trees are found, but maize, wheat, and barley are cultivated. Unfortunately, the cereals do not always ripen, as the upper limit of cultivation is near. The grasslands support large herds of cattle, llamas, and sheep.

The Equatorial Lowlands or Amazon Type—

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Manaos (Brazil)	121 ft.	75° F.	78° F.	86 in.	At all seasons
Lagos (Nigeria)	25 ft.	77° F.	79° F.	70 in.	
Equatorville (Belgian Congo)	1,050 ft.	76° F.	76° F.	68 in.	

The equatorial lowlands have high temperatures at all seasons, and rain falls throughout the year, with two relatively wetter seasons at the equinoxes. Dense primeval forests, in which an immense number and variety of trees struggle for existence, exhibit the supreme effort of plant-life. "Above in the dazzling sunshine is a sea of verdure aglow with islands of gaudy colours, on and in which gorgeous insects, birds, tree-frogs, and numerous small mammals are extremely busy. Below, lies a stupendous gloomy vault, crowded with pillars, encumbered with ropes and cables, hung everywhere with baskets of foliage, and laid with a soft and elastic brown mat, hidden here and there by a mass of broad, variegated leaves."

The damp, steaming heat and the dim light of the denser forests make them Regions of Debilitation for the migrant white traders, and the degraded native tribes. Plantations in the forest clearings, superintended by their white owners, depend for their success on the state of development of the native people. Cacao, manioc, sugar, rice, bananas, rubber, balata, gutta-percha, plantains, yams, and coconuts are the typical plantation products. The timber of the vast forests, owing to climatic, transport, and labour difficulties, is almost untouched. Mahogany, ebony, lignum vitæ, log-wood, and brazil-wood are exported to industrial lands, and the products of the coconut palm and oil-palm have become of great importance in recent years. The gathering of wild rubber, balata, and gutta-percha by enforced or induced native labour, provides much of the world's supply of these commodities. A large proportion of the native inhabitants are primitive hunters or fishers, and the clearings of those who practise rudimentary agriculture are mere specks in the immensity of the natural forests and jungles. Mining is of little importance, except the tin and gold of West Africa, and industries are practically non-existent. Little trade is done between the various regions, but their products are now so important to the great industrial countries that the ownership of these lands has become of international importance, and scientific research is seeking to make them habitable for the white races. It would seem from present factors, however, that the white man will never be a permanent dweller, but will supply the necessary skill in management and organization on the plantations for a limited period, while the essential labour will be supplied by the natives. The danger lies in exploitation of the natives and the restriction of the exported products to the more powerful lands only.

Many parts of the equatorial lowlands are Regions of Lasting Difficulty, possibly everlasting. Thus, the Amazon lowlands are, on the whole, one of the least populated and least utilized regions of the world. Their super-abundance of water, constant damp enervating heat, and tropical diseases are almost as inimical to human life as the harsh climatic and soil conditions of the polar regions. The Congo Basin offers easier conditions, and is more thickly peopled. Though only recently acquired by Europeans, it will probably be developed before the Amazon valley.

The Equatorial Mountainous Island Type—

Name of Place.	Height above Sea-level.	Mean January Temp.	Mean July Temp.	Mean Annual Rainfall.	Seasonal Distribut'n of Rainfall.
Batavia (Java) .	23 ft.	78° F.	78° F.	71 in.	At all seasons
Singapore . .	10 ft.	78° F.	82° F.	93 in.	

Sea winds and elevation secure Malaya more favoured conditions, and, consequently, denser populations than the other equatorial lands. In the tropical forests there are extremely backward races, but the sea has given access to many immigrants, who have greatly raised the level of the native populations of some of the islands. Tropical agriculture on scientific lines produces coffee, tea, sugar, tobacco, sago, rubber, balata, and gutta-percha. Mining for tin is of great importance, and sea-faring has long been a pursuit of the inhabitants. Spices from the forests have formed important articles of trade for many centuries. Before the advent of Europeans, Malaya had reached a high stage of civilization, a fact attested by the mysterious ruins of its former magnificent cities.

Man's study of the Natural Regions leads to his perception, imperfect though it be, of the early strivings of the earth to establish the physical environment suitable to cosmic life, the later birth and development of animate nature, and the growth in him of ideals. He recognizes that he is part of the earth's control, the highest product of her evolution, and the destined agent to secure order and harmony in a world of strife.

CHAPTER VII

THE FISHING INDUSTRY

> " The ocean's fields are fair and free,
> There are no rent days on the sea."—*Old Fisher's Song.*

THE sea furnishes three of the great haunts of life—the littoral, pelagic, and abyssal regions ; contains the most abundant and the largest fauna of the earth ; and is more productive of food than the land. Its surface is a vast pasture, the bulk of the green plants in its upper waters much exceeding man's carefully tended fields of lush grass. Fish life depends on the abundance of food in the waters, and on the depth, warmth, and salinity of the waters. " All flesh is grass," and although some fish prey on other fish, yet the animals of the sea, like those upon the land, need plant-food as a basal food supply, since animal life has not the power of transforming mineral substances directly into organic tissues. Minute unicellular marine plants by means of their green chlorophyll are able to utilize the sun's rays in photosynthesis, transforming the inorganic constituents of their environment (air, water, and salts) into fat, albumen, and carbohydrates. Thus, directly or indirectly, all marine life depends upon these minute organisms. The colder waters are more productive of plant-life than the tropical, on account of the decreased activity of denitrifying bacteria, and the greater abundance of nitrates and nitrites in cold waters.

The two great conditions which control the type of animal to be found within any part of the sea are the presence or absence of light, and the presence or absence of a substratum. At the margin of the sea, where the light penetrates to the bottom, there is the littoral haunt. In the open water occur pelagic forms, which require no substratum, but usually demand light, and often display sensitiveness to it. Finally, in the deep ocean abysses, exist peculiar abyssal forms entirely independent of light, but, directly or indirectly, dependent upon the presence of a substratum. The life-history of a fish is not necessarily restricted to one of these regions. Many littoral forms have pelagic larvæ or pelagic stages in their life-history.

THE LITTORAL AREA.—Zoologists define the littoral area, or the shore of the sea, as the relatively shallow, well-illuminated continental shelf, which is characterized by its great wealth of food, and the great variations in its physical conditions. Probably, in this zone, where sea and fresh water, earth, and air all meet, where food is abundant and oxygenation great, living organisms first found foothold, and gained racial qualities of alertness, patience, and endurance. The basal sources of littoral food are the nutritive waste of the land, the fixed algae of the shore rocks, and the minute floating algae or phyto-plankton. Though not a large haunt of life, the shore is a long and very populous haunt, the scene of a great struggle for existence, where organisms show wonderful adaptation in parental care of their offspring, in struggling for food and fresh air, and in combating scouring tide and pounding breaker. Tides and currents, bringing constant supplies of food and oxygen, ensure that no stagnation shall occur. Unlike warm-blooded land animals, sea animals (with the exception of those descended from terrestrial ancestors) do not possess a heat-regulating mechanism, whereby they can adjust themselves to changes of temperature. Some fish, however, are tolerant of great variations in the temperature of sea-water; while others are rapidly killed by them. The former—generally littoral animals of temperate latitudes—are known as eurýthermal, the latter—usually those of tropical and polar seas—as stenothermal. The contact of a cold current with a warm one seems often to lead to a great destruction of animal life; and variation in the salinity of the water seems to have the same effect. Among littoral fishes are the mussel, cockle, oyster (mollusca); lobster, crab, prawn, shrimp (crustacea); plaice, turbot, and skate, fitted by shape to life on the sandy bottom; and the ground-feeding cod and haddock.

THE OPEN SEA.—Spacious, bountiful, and relatively easy conditions of life are provided by the pelagic haunt or open sea. It includes the well-lighted waters beyond the shallow waters of the shore, and stops with the light. Light becomes very dim at a depth of 250 fathoms, and probably below a depth of 900 fathoms absolute darkness reigns. Abundance of food for minute pelagic crustaceans is afforded by the inexhaustible floating "sea-meadows" of microscopic algae, and these crustaceans are eaten by fishes, which, in turn, enable the toothed whales to live. The animals of the open sea are divided into the active swimmers (nekton), and the easy-going swimmers or drifters (plankton). The swimmers include whales and their allies, mackerel, sprats, pilchards, and herrings; while the drifters, often furnished with flattened and expanded bodies, are represented by minute crustaceans, globe-fishes, and flinty-shelled radiolarians. Tides are of little importance in pelagic haunts, but currents are of very great importance. When currents bringing cold water of relatively low salinity meet warm currents of highly saline water the warmer water floats on the surface of the colder, and there is a junction layer where a sudden change in temperature, salinity, and specific gravity occurs. Such meetings are found in the Norwegian Sea, where the Polar drift meets the warm currents of that sea; off the eastern coast of North America where the Labrador current meets the warm Gulf Stream; off the Cape of Good Hope where the cold Benguela current meets the warm Agulhas current; and off the Japanese islands where the cold Kurile current meets the warm Kuro-Siwo. Great mortality occurs among the pelagic organisms in these regions, for the delicate food-plants and the myriads of creatures which feed upon them are either killed by the sudden change of temperature, or find themselves unable to pass through the lower layers of dense water, and so accumulate in large numbers in the upper layers. In consequence, there is a vast bulk of dead and living food for cod, haddock, herring, and mackerel.

THE DEEP SEA.—The deep sea or abyssal region, the great unseen haunt of life, is a region of eternal winter and of eternal night, of deepest calm, unbroken silence, and unimagined monotony. In adaptation to the enormous pressure—2½ tons to the square inch at a depth of 2,500 fathoms—the bodies of deep-sea animals are usually very permeable, so that the water gets through and through them, and equality of pressure is thus maintained. The great tactility displayed by the organisms, the long stilt-like legs developed by the active animals which enable them to live on the treacherous ooze, and the lifting of the sedentary types on the ends of long stalks, which have their bases embedded in the mud, are answers given to the problem of their environment. There are no plants in the great abysses, but the surface organisms, both plant and animal, which sink upon their death through the miles of water, feed the smaller animals of the deep, upon which the larger live. Millennium after millennium littoral animals have followed the down-drifting food, and have adapted themselves to their strange environment. They are as fit, fine, and vigorous as those of the other haunts. Sponges, corals, sea-lilies, and fishes form a thick population, and prove the insurgent nature of life.

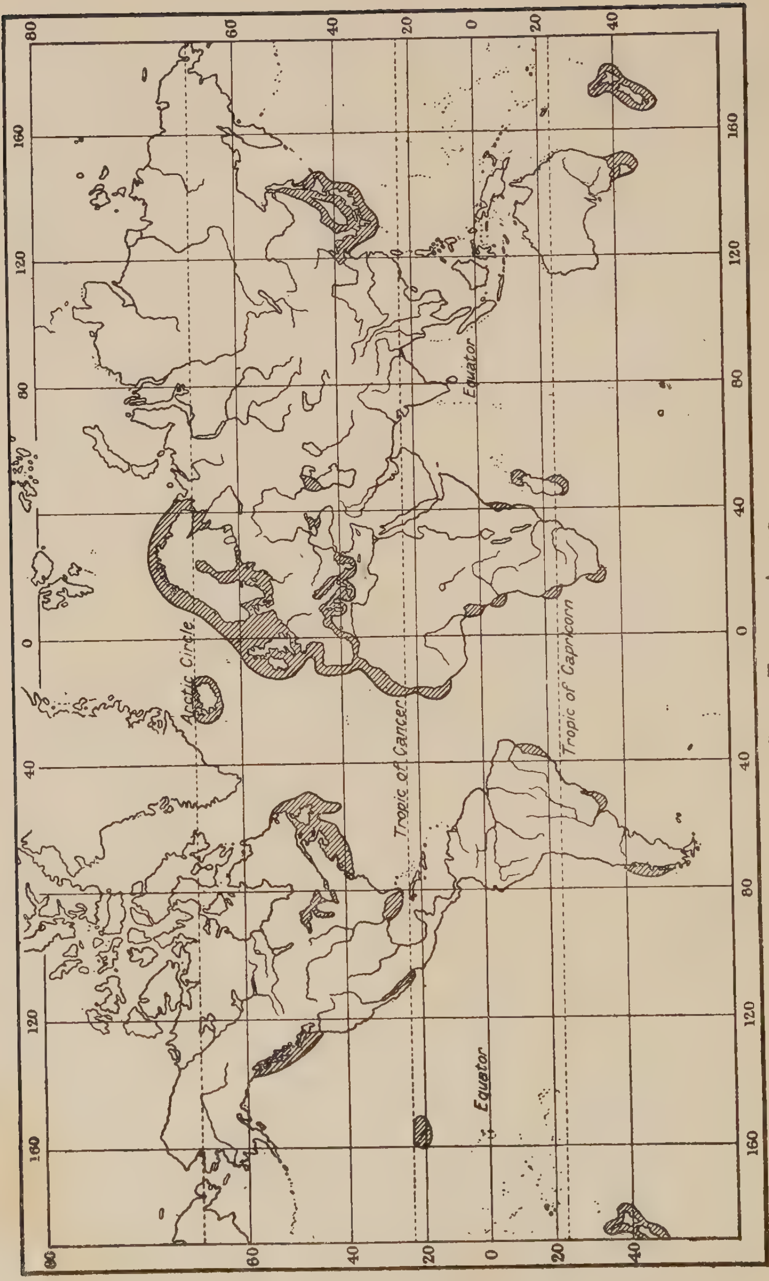
The chief fisheries of the world are in the littoral and pelagic haunts, but more especially in the former ; the deep-sea bottom and intermediate layers are not drawn upon at all. Among the forms obtained are burrowing animals like the clam, fixed animals like the oyster, crawling kinds like the lobster, and free-swimming kinds like the fishes. All the great groups of the animal kingdom contribute to the food supply from the sea ; but by far the most important are the true fishes. Some of these are surface swimmers like the herring, sprat, pilchard, and mackerel, which are migratory and are found within 100 ft. of the surface. They are called pelagic fish, and their food consists of animal and vegetable plankton and small fry. A larger number of fish live on or near the shallow bottom, like the halibut, haddock, plaice, turbot, sole, flounder, and cod, which seldom move far away from their feeding ground. They are termed demersal fish, and their food is mainly hermit-crabs, worms, sand-eels, shell-fish, and other small animals, which live in the mud brought down by rivers and deposited on the sea-floor. Other fish, notably the salmon and shad, though living in the sea the greater part of their lives, ascend into fresh water to lay their eggs or spawn. Generally, the cool temperate seas, because of the large amount of vegetable life found in them, swarm with immense shoals of a few distinct species of fish, the flesh of which is excellent food ; while the tropical waters harbour a far greater variety, remarkable for colour and form, but fewer in number and less edible.

METHODS OF FISHING.—Trawling and Lining. Demersal fish are caught by trawling and lining, pelagic fish by drift-netting. Some pelagic fish, however, such as the herring, seek the bottom of the sea during the day-time, and are caught by the trawlers. The trawl, the most important implement of fishing, is a conical bag of netting (about 70 ft. wide and some 110 ft. long) dragged along the bottom of the sea, at the rate of 2 to 6 miles an hour. The old-fashioned type of trawl-net, still used by the smacks, is attached to a beam of wood, to either end of which triangular iron frames—the trawl-heads—are in turn affixed. The upper end of the net is attached to a head-rope, which is laced up to the beam. The lower margin of the net is attached to a much heavier rope, the foot rope, which curves back widely between the bases of the trawl-heads. When fishing, the whole arrangement is dragged along by means of two ropes—the bridles—attached to the heads. The bridles are shackled together, and from the shackle the single trawl-warp leads to the vessel. Traps or pockets in the net prevent, or at least hinder, the egress of the fish. A small trawl with a fine mesh is a favourite device for the capture of shrimps. In modern steam trawlers the "otter" trawl is used. In this instrument the beam is abandoned and the heads are replaced by two large boards, which are shod with iron, and are somewhat larger than ordinary doors. One great advantage of the otter trawl is that the width of the mouth of the net can be greatly increased. The heavy and clumsy beam is replaced by a strong head-rope. The net is kept open by the reaction of the water on the pair of boards. Each board, and consequently each end of the net, is attached to the steamer by a separate warp. A steam trawler carries two trawl-nets in readiness for instant use, one on each side of the ship. On the fishing grounds fishing is continuous. The duration of a haul is from 5 to 6 hours, and as soon as the net is hauled and cleared it is shot again. Trawling is possible at depths of from 5 to over 200 fathoms, but beyond 100 fathoms it is not yet extensively practised on a commercial scale. Many trawlers go out to the banks for months at a time, and are attended by steamers, known as "carriers," which collect the fish, and convey them to ports, from which express fish-trains run inland to the great industrial centres.

Drift-netting. Drift-netting for pelagic fish is carried on by both steamers and sailing-vessels. The drift-net is a completely submerged vertical wall of netting, supported on a line carrying cork floats, which is in turn attached to ropes and buoys supporting the net at varying depths from the surface. A fleet or train of nets, 70 in number, each of which is 40 yds. long, may frequently be seen attached by a rope to a steam-drifter, and drifting with the tide.

The mesh of the net is of uniform size, varying with the fish it is expected to catch. A herring-net, generally, has from 33 to 36 meshes to the yard; a pilchard-net 45 or more; a mackerel-net 25 to 28. The success of the fishing depends on encountering a shoal of fish of the requisite size. The fish strikes the net, its head slips through, and the increasing diameter fixes it in the net. Some demersal fish such as the cod, are caught also by long lines furnished with several thousand hooks baited with mussels, squids, herrings, and capelan. A long line may be several miles in length. At regular intervals pieces of line from 2 to 3 ft. long, the "snoods," are attached, and these carry the hooks. The line is usually shot in the evening and fished in the morning, its position at sea being marked with buoys. Salmon are caught in stake-nets or seines at the mouths of rivers. Seining, one of the latest methods of fishing, is said to be capable of covering a larger area and securing a greater catch than can be done by the other methods. It consists of two specially-constructed vessels working together with one net between them. Working against the tide, they gradually draw together, and the catch is eventually hauled on board one of them. Hull is especially associated with this method.

FISHING GROUNDS.—Temperate and Cold Seas. It has been shown that fish-life is most prolific in temperate and cold shallow seas, owing to the abundant organisms on which fish feed finding there their best environment. Fishing is, however, carried on, to some extent, in all waters. British fisheries range from the shores of Portugal and Morocco northward to the Barents Sea. With the largely increased use of steam engines in recent years, increased advantage has been taken of distant fishing grounds, which are often found to be more prolific and profitable than home waters. Of all the trawling areas that of the North Sea is much the most important. Practically every variety of demersal fish is recorded from its fishing grounds; but, broadly speaking, the predominant species are the cod, haddock, and plaice. Plaice and soles are found in greater abundance in the southern portion, especially on the Dogger Bank, which rises to within 60 ft. of the surface; and cod and haddock in the deeper, more northerly regions. The Barents Sea yields mainly plaice; the Iceland Banks and the Faröes cod, haddock, plaice, halibut, ling, and coal-fish; the northern and



Chief Fishing Areas

western coasts of Scotland, haddock, ling, skate, ray, coal-fish, hake, and bream; the west and south coasts of Ireland, hake, haddock, megrims, and bream; while the Irish Sea and Bristol Channel produce soles, plaice, skate, and ray. A large proportion of the fishing in the English Channel takes place in the shallow inshore waters, and the area is exploited chiefly by small fishing vessels. The Biscayan grounds yield hake; while soles, hake, and skate form the major portion of the catch from Moroccan and Portuguese waters. Ordinarily, herrings are widely scattered in deep water, but at certain times of the year they come together in shoals in the warm water of the continental shelf for the purpose of spawning. They are then richest in fat, and most easily caught. British drift-netting for herrings begins on a large scale in the middle of May off the west coast of Scotland, the chief centre being Stornoway. In early June herrings are caught off the Orkneys and Shetlands; then in succession off Wick, Fraserburgh, Peterhead, Berwick, Blyth, Shields, Scarborough, Hull, and Grimsby. At Yarmouth and Lowestoft the herring fishing commences in late September or early in October, and the last herrings are caught in the waters of Devon and Cornwall in December. Herring is the most valuable species of fish caught in British waters or landed in the British Isles. Most of those landed are caught on the east coast. Off the Cornish peninsula the chief fish caught are pilchards and mackerels, the latter frequenting the waters between Devon and the south coast of Ireland. Oysters are obtained in sheltered inlets at Whitstable, Brightlingsea, and Colchester; and lobsters are caught in baited wicker traps on all the coasts, but especially in Scotland and Ireland. The British fisheries are the richest in the world; and, of the entire catch, herring, cod, and haddock together account for three-fifths of the value. Great Grimsby, the chief centre of the North Sea fishing industry, is the largest fishing port in the world, and Billingsgate, the metropolitan fish-market, excellently served by fast trawlers and trains, is the largest fish market. About 125,000 whole-time fishermen are engaged in British fisheries—55,000 in England, 45,000 in Scotland, and 25,000 in Ireland. Scotland furnishes one-third of the output, but the Irish share is comparatively small owing to poor methods and instruments, long distance from markets, and lack of progressiveness. In Europe, Russia, France, Norway, and Germany have the largest fishing industries after those of Britain; the shares of Holland, Denmark, Spain, Portugal, and Italy are much smaller. The Russians have fisheries in the Arctic and Baltic Seas, the Sea of Azov, the Caspian lake, and in the numerous rivers. Large quantities of sturgeon are taken, and from its roe caviare is prepared. Norwegian fisheries are most important round the Lofoden Islands; they include cod, herring, mackerel, salmon, and sea-trout, cod forming half, and herring one-fourth of the total catch. France obtains cod from the fishing grounds of Iceland, Newfoundland, and the North Sea; sardines from Biscayan sources and the Mediterranean Sea; mackerel from the Biscay coast; herring from the North Sea; tunny and anchovy from the Mediterranean sea; and lobsters and oysters from sheltered western estuaries. The Mediterranean Sea contains only a small variety of fish, the flesh of which is generally coarse. Among its fisheries those for the tunny, sardine, and anchovy are valuable. Sponges are dredged in the Aegean and eastern Adriatic seas, and off the shores of Tunis and Tripoli; and the Italian and African coasts are important sources of coral.

North American Grounds. North America possesses two important fishing regions—that off its north-eastern shores where are the Newfoundland Banks, and that off western Canada and Alaska. The Grand Banks of Newfoundland consist of a chain of submarine plateaux, richer in cod and other fish than any other known parts of the ocean. They stretch for about 300 miles in a south-east direction from the coast of Newfoundland toward the middle of the North Atlantic, and are larger than Italy. Plankton in inexhaustible quantities is conveyed to them by the Labrador current and the Gulf stream, thus providing excellent food for the many marine animals on which the cod, haddock, halibut, and pollack feed. Vessels from Newfoundland, Canada, France, the United States, and Norway are always at work on the fog-veiled banks, their chief catches being cod and halibut. Newfoundland, Nova Scotia, New Brunswick, Massachusetts and Maine have enormous catches of cod, herring, haddock, and mackerel. Farther south the shad replaces the herring, and the alewife and menhaden are taken. Sponges are obtained in the waters of the Gulf of Mexico, the Bahamas, and Florida; and lobsters are a special product of the coasts from the New England states southwards as far as Delaware. The oysters of Chesapeake Bay and Long Island are famous; and sturgeon and white-fish are obtained from the Great Lakes. A great commercial salmon fishery has been developed off the coasts of Alaska, western Canada, and north-western United States; but herring, cod, and halibut are also caught. The rivers Columbia, Sacramento, Fraser, and Skeena have also famous salmon fisheries.

Pacific Grounds. Japanese fisheries are among the most productive in the world, the submarine banks being supplied with plankton and other food by the Kurile current and the Kuro-Siwo. Fishing ranges from the Sea of Okhotsk to Australia, but most vessels are engaged in home waters, especially those of Yezo, where the chief fish caught are the bonito, cuttle, mackerel, sole, cod, mullet, eel, and salmon. In all the Asiatic monsoon countries fish forms a chief article of diet, and the river fisheries of these lands are, therefore, important. China has extensive river and coast fisheries, but has to import largely from Japan. The trepang, or bêche-de-mer, a kind of sea-slug, finds a ready market in China, and fisheries for it extend from Malaya through the Pacific islands to California. The coastal fisheries of Australasia are not yet developed.

Whale and Seal Fishing. The term "fishery" is applied, though incorrectly, to the hunting of whales and seals. The seal fisheries are mainly an industry of the polar regions. "Seal-skin" is not supplied by the true seal, but by the sea-bear, which is found in the Bering Sea and the South Pacific Ocean, especially on the Pribilov and Commander Islands. In the Southern Hemisphere, the fur-seals are found about Cape Horn; on the Falkland, Lobos and Crozet Islands; and in South Africa, Kerguelen Island, South Australia, and New Zealand; but they are of less value than those of the north. From May to July the northern sea-bears herd in "rookeries" on the rocky beaches; and all migrate southward about November. Seal hunters drive the animals from the beaches to inland killing grounds, taking care not to kill the breeding females. Pelagic sealing—hunting at sea with gun or harpoon—does not allow of the same care, and because of the great reduction in the number of seals caused by indiscriminate slaughter the hunting and the numbers taken are now regulated by a joint commission of the British, Canadian, Russian, Japanese and American Governments. Even more scarce than the fur seal is the sea-otter, which is found on North Pacific shores, especially in the Aleutian Islands. Its splendid fur is highly prized. The true seal, hunted in all Arctic waters, is taken for its hide and blubber, its coarse hair being of little worth. Its blubber or coating of fat beneath the skin, when boiled down, yields train oil, which is also obtained from many whales. The Greenland or Arctic right whale belongs essentially to Arctic waters, and is hunted for the long bony fringe that lines its jaws—whalebone—and for the oil yielded by its warmth-preserving blubber. Round Iceland and Jan Mayen Island, Norwegian fishermen hunt the bottle-nosed whale, from which an oil akin to sperm oil is obtained. The rorquals or fin whales, and hump-backed whales range from Norway to Newfoundland, and, like the great sperm whale of tropical waters, are pursued for their blubber. The bowhead whale frequents the Bering and Okhotsk Seas, while the black whales have their habitats in the waters off South Africa, Kerguelen Island, New Zealand, and Australia. Dundee and Peterhead in Scotland, New Bedford in Massachusetts, and San Francisco are the whaling ports of the north, and South Georgia and New Zealand are the chief southern whaling centres. Whale fisheries have declined in recent years, both the black and right whales having become seriously reduced in number. Other products of the polar waters are the horn of the narwhal and the tusks of the walrus, which furnish inferior ivory. The walrus also yields oil.

Products of the Warm Seas. Articles of marine origin, used for ornamental purposes, are characteristic products of the warm seas. Coral is found in many tropical and sub-tropical waters, notably Pacific waters. Pearls, formed by certain molluscs by a process of secretion, are found in the Malay seas, off the north and west coasts of Australia, to the north of Ceylon, in the Persian Gulf and the Red Sea, in the Gulf of California and the Bay of Panama, in West Indian waters, and in some of the lagoons of the Pacific Islands. The fresh-water mussel, yielding very large and lustrous pearls, is found in some of the rivers of western Europe (notably German rivers), America, and China. Pearl-shells, from which the iridescent mother-of-pearl is cut, are a product chiefly of the west

Australian fisheries. The marine turtle, which yields tortoise-shell, is found on tropical coasts, the best shells coming from the Malay archipelago, the West Indies, and Brazil. Cowries, small shells used as money by uncivilized tribes, are collected on the shores of the Indian and Pacific oceans. Marine animals yield many useful oils. Oil is obtained not only from the whale, seal, and cod, but also from the dugong, hake, haddock, herring, menhaden, sturgeon, shark, grampus, and porpoise. Isinglass, used in clarifying wines and in confectionery, is prepared from the swimming bladders of various fishes ; while various kinds of leather are manufactured from the skins of the seal, porpoise, shark, and ray.

The perishable nature of fish has led to the development of great salting, freezing, drying, and canning industries, without which the exporting countries could not supply the heavy demands of the Catholic countries in Europe, Central and South America. The American demand is met by salted cod from Canada and Newfoundland, and the European by salted cod from Norway, and salted herrings from Norway and Britain. Canned salmon is shipped in great quantities from Alaska, Canada, and the United States to Europe. It is noteworthy that Britain leads all other countries in the export and import of fish.

In recent years attention has been given in Europe and North America to pisciculture and research work on fish life. Wasteful methods of fishing are slowly dying out, and the problem of the meat supply is compelling thickly populated countries to recognize that fish provide the cheapest complete nutriment, and an inexhaustible stock of natural wealth. Fishing breeds a healthy race of men, who embody those qualities of self-reliance, grit, and love of adventure which are among the greatest of national assets. It is to the fishing industry that Britain largely owes her naval strength, her colonies, her endurance, her sea-trade, and her political freedom.

CHAPTER VIII

Mining and Manufactures

> "Civilisation should mean a diminishing proportion of dull and oppressive industry and an increasing freedom for self-chosen occupations. It is a chief end of science to conduce to this progressive liberation of man."
>
> —*J. A. Hobson.*

(*a*) **MINING.**—Minerals have been, in all ages except the most primitive, of prime importance in determining the distribution of man and his settlements; their attraction is strong even in regions where climatic disadvantages are great or where transport facilities scarcely exist. Nature, by determining the presence or absence of mineral resources, localizes mining and fixes its duration. Mining is largely a transport industry, and demands for its basis an acquaintance with most of the applied and natural sciences. At an early stage of his civilization man found it advantageous to burrow into the earth to extract nature's treasures. In Eastern lands mining was practised from remote antiquity, and there is little doubt that gold was worked at a very early period in Britain. Mining on a vast scale, however, is a modern industry demanding huge capital, the application of science to its problems, and great organizing powers from its directors.

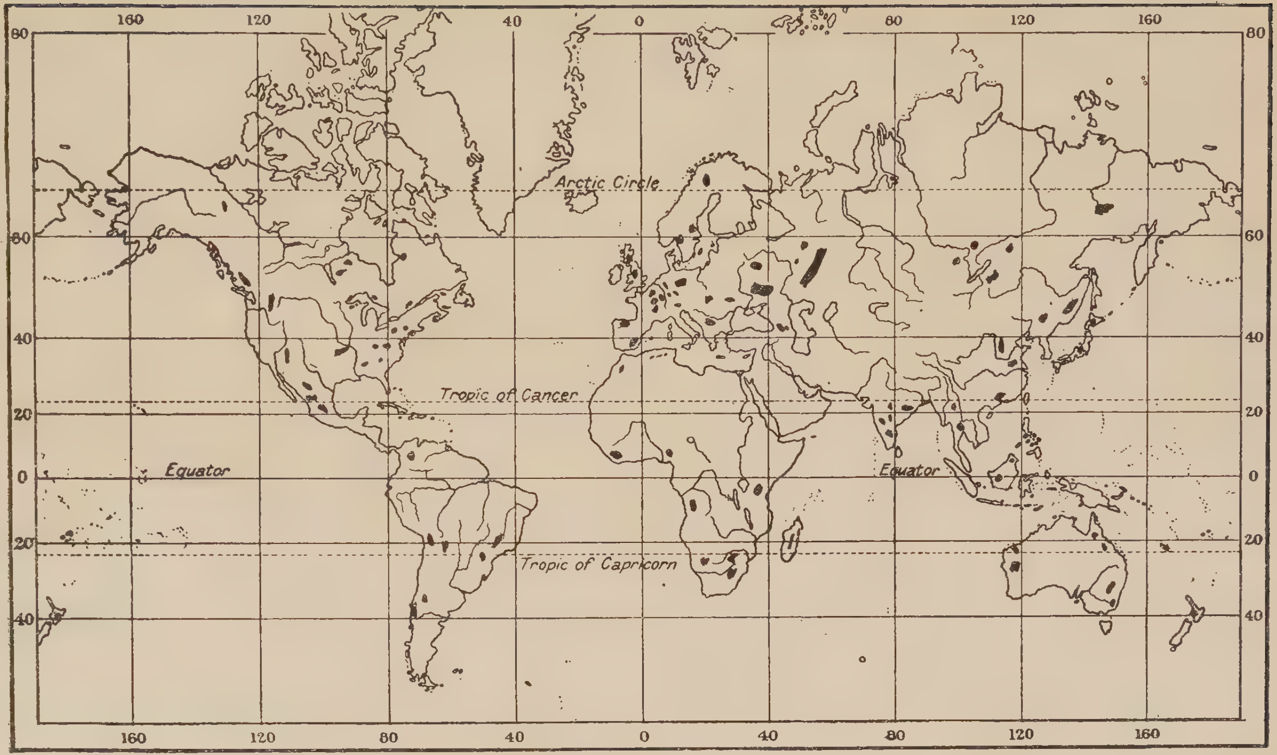
Most mineral deposits, and especially those of the metallic ores, have been formed far beneath the surface of the earth, and are, therefore, found mainly in the older rock-formations. Where the deep-seated rocks have been up-folded and then exposed by denudation mining is most active, and throughout the world there is a close relation between young and old folded mountains and mineral wealth. Clays, coal, oil, salt, and certain building stones may be found on plains; but the great mining regions are associated most commonly with the old worn mountains (crumpled bands), or with mountains which have passed through one cycle of denudation and have started upon another, and more rarely with the young folded mountain regions. A process of segregation is generally necessary to bring together the small particles of metallic compounds, scattered through a great mass of igneous rock, into ore bodies of workable size. It takes place in two chief ways—volcanism and the action of water. Volcanism has played an important rôle in the development of many mineral veins. The heat and the gases accompanying volcanic action have given to water in the interior of the earth a solvent power of great potency when transferring mineral matter from one point to another; the lavas have contributed much of the mineral for solution, transportation and deposition in veins; and the mountain movements have furnished the necessary crevices in which the vein deposits lie. Water, percolating through rocks, dissolves the widely scattered particles of the oxides, sulphides, and other compounds of the metals, depositing them later when the solution has become concentrated by the addition of material from a wide area. Hot water, expelled by igneous rocks lying at considerable depths (magmatic water), generally carries the metals upwards, giving rise to much of the metallic wealth of the world. Thus, volcanism, directly and indirectly, makes available a large part of the mineral wealth. The common metals are found in rocks of nearly every geological age; but are mainly met with in igneous and crystalline rocks, and occur most often as ores. They are rare in undisturbed rocks, and, consequently, the great alluvial plains of the world are poor in minerals. It does not follow that because rocks of a certain geological age bear certain minerals in one region they will do so in another. Generally speaking, the harder rocks are less productive of minerals than the softer, and the main range of a mountain system less so than its flanking ranges.

The formation of ores is probably largely limited to a zone within a few thousand feet of the surface of the earth, and is highly spasmodic even there. Even among the mountains and the outer 10,000 feet of the crust of the earth, where ore deposits are formed, the constant succession of new discoveries of ore is not too hopeful, and man is not likely to find many ores at much greater depths. Mineral wealth, unlike agricultural wealth, must eventually be exhausted. The richest and most accessible deposits are first obtained, then the poorer ones, until finally what is left is not worth mining. Improvements in methods of mining or economies in the methods of extracting the metal from the ore may make it profitable to mine at greater depths or to utilize deposits once considered worthless, but ultimate exhaustion of mines is certain. The mining industry is, therefore, transitory in character. Depth of mining is important; for the difficulty and cost of working increase with the depth. The deeper the shaft the longer must be the haulage to the surface, and the greater heat makes labour more difficult and ventilation a harder problem. All minerals, as yet, are mined within a mile of the surface of the ground; mines become warmer so rapidly as they go deeper, that, if it were possible to sink them to a depth of two miles, the air would be as hot as boiling water. Man is unable to stand prolonged dry heat of more than 120° F. or moist heat above 105° F. In the copper fields of Michigan, mining is carried on at a depth of 5,000 ft.; in the gold mines of the Transvaal at 4,000 ft.; in the coal mines of Britain at 3,000 to 4,000 ft. The plant of a large mine is little more than a long series of narrow railways through long tunnels with a few shafts for vertical traffic; and it is essential in an old mining country that there should be unbroken continuity of transport of the mineral from the face of the working to the top of the shaft. The main causes of the general increase in the size of mining concerns in "old" countries are the exhaustion of the easily accessible veins, and the consequent necessity of sinking deep shafts, installing expensive hoisting apparatus, and the laying of long lines of railway underground. Fixed capital—shafts, galleries and machinery—plays a very important part in modern mining. In no other branch of industry are there such large amounts of capital risked at the same time. Mines vary considerably in their working periods. Tin mines have been worked for hundreds of years; oil-wells are often exhausted in a few years.

Like agriculture, mining makes heavy freights for the railways; and the existence and prosperity of mining industries depend upon the wealth of the mineral deposit, the cost of bringing it to the surface, and the facilities for making use of the mineral in the immediate neighbourhood, or for transporting it to other parts where it is wanted. In the case of coal and iron mines it frequently happens that mines have to be closed because they are incapable of withstanding the competition of richer deposits. Where transport is either too costly or lacking, mineral deposits may long remain unworked, even if known. Lack of capital, poor transport facilities, and absence of skilled labour and organizing ability, explain the infancy of mining in the rich mineral regions of China, the Balkan countries, and Spain. Sometimes the extreme richness of a deposit makes man contend with very great difficulties in mining. In the Arctic wilderness, the rich Alaskan gold-fields are worked; while, in Western Australia, gold is mined in the heart of a hot desert, the water supply being drawn from the coastal districts, a distance of 330 miles.

The rapid development of mining since the late decades of the eighteenth century is intimately connected with advances in the engineering and chemical branches of science, and bound up with the use of fuel for smelting ores and working steam engines. Two of the most important factors in modern mining are the possession of fuel and the possession of iron ores. Till 1898 Britain led in the production of coal, but is now easily surpassed by the United States, and in the production of steel and iron she has been exceeded by both Germany and the United States. China, Russia, and Canada have almost untouched rich mineral resources, and should attain leading positions in the mining of the future. Britain early developed her mining; her mines are, therefore, deeper and more exhausted than those of younger mining countries; but the inventive skill and organizing ability of her people, her great capital, her excellent transport facilities, and her pre-eminent trading position still help her to counterbalance the disadvantages of thin seams and veins, and great difficulties of mining.

Mineral Products. IRON. Very widely distributed and of great utility, iron has become the universal material for tools and machines and one of the most important factors in promoting civilization. Few lands are devoid of iron ores, but the various ores have very different values and their working depends on their accessibility, richness, nearness to fuel, and freedom from impurities. Those of chief commercial value are magnetite (black oxide, the richest of all iron ores), haematite or specular iron (red or brown), spathose (iron carbonate), iron stone or blackband (usually found between the layers of coal), and pyrites (too expensive to work for iron, but used to produce sulphuric acid and copper). The presence of silica, other metals, sulphur, phosphorus, and arsenic in iron-ores is deleterious, and many ores were, therefore, formerly useless. Much wealth and research have been expended, often successfully, in finding a material, which, when added to the iron, will take away the effect of the impurities and produce a material as good as pure iron. When iron is melted in the blast furnace, and the metal cast into moulds, it is known as pig iron, and usually contains about 5 per cent of impurity. The kind of impurity, or its absence, decides how steel can be made, and what qualities of steel will result. Pig iron from spathose and red haematite is practically free from sulphur and phosphorus, but that from blackband and brown haematite (minette) contains phosphorus. Sulphur makes steel brittle when hot, and so impossible for forging or hammering; while phosphorus causes it to become brittle when cold. For making hard steel there should be less than 0·1 per cent of sulphur, and 0·03 per cent of phosphorus. The bad effects of sulphur are usually avoided by mixing two ores, one containing manganese (spathose and brown haematite) and one without any, until the correct proportion is obtained. The phosphorus ores were almost useless until the "basic Bessemer" process was invented. This depends on mixing the pig iron with non-metallic materials, which do not affect the steel, but extract nearly all the phosphorus from the iron. The process is expensive, and so is usually used only when there is no other ore but phosphorus ore. The richest iron-ores, haematites and magnetites, have about 65 to 70 per cent of iron, but ores with over 40 per cent are well worth working. Lower-grade ores (those containing 25 per cent of iron or more) are worked where conditions are favourable, and are concentrated for export, sometimes with the help of water-power as in Norway. Of the materials required for the manufacture of steel, iron ore and coal are used in the largest quantities. As it takes less than a ton of coal to smelt a ton of iron ore and produce pig-iron, but more than a ton of coal to turn a ton of pig-iron into finished steel articles, the tendency is to produce pig-iron on the iron-fields in many regions, and move it to the coal-fields for further manufacture. This tendency is enhanced by the facts that the cost of carriage of the coal is less than that of bringing the ore to the coal, and the cost of land is not so great. The deposits of iron ore most worked now are those rich in iron, those on or near a coal-field, or those to which coal can be conveyed by cheap water transport.



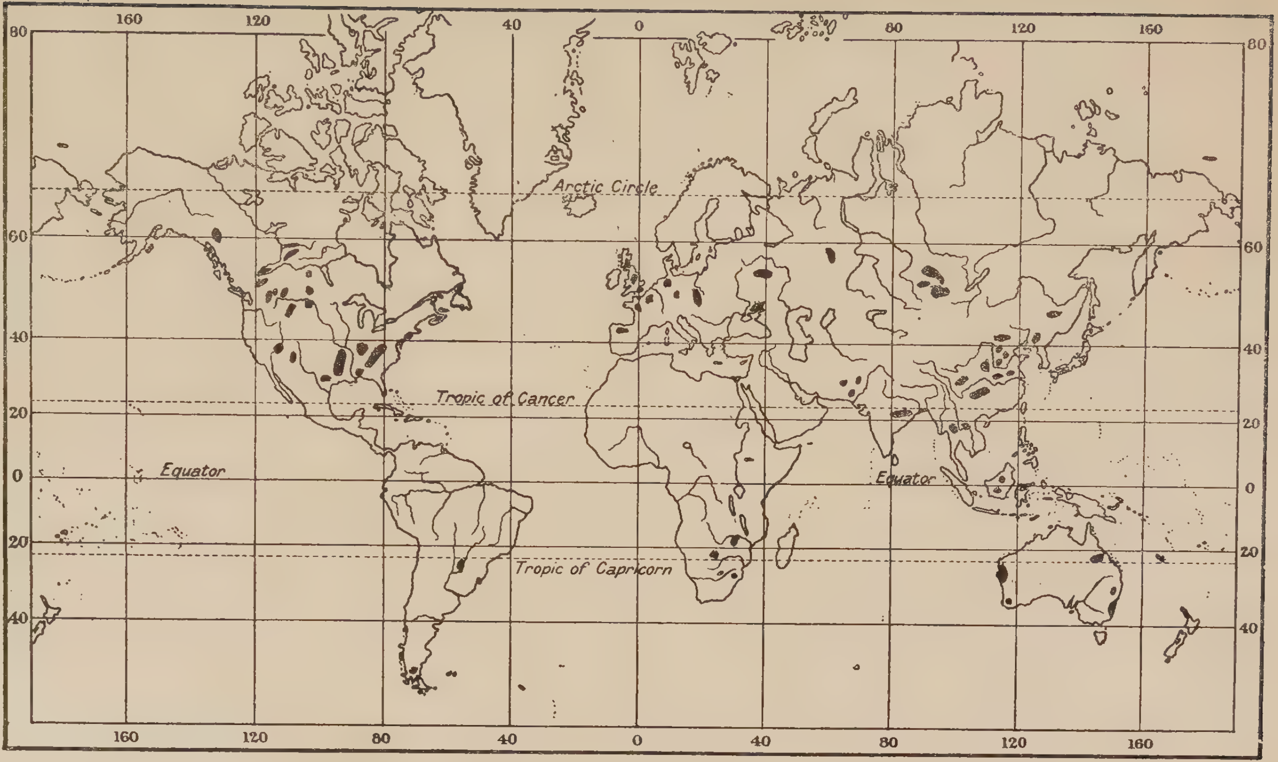
DISTRIBUTION OF IRON

The United States is the greatest iron-producing country in the world, using mainly its own ores (small supplies of Swedish and Spanish ores are imported), which are found chiefly around Lake Superior in Minnesota, Michigan, and Wisconsin ($\frac{6}{7}$ of the supply), and in the Appalachians from Alabama to central New York. The red haematite and magnetite of the Lake Superior district are quarried by steam-shovels at a very cheap rate. Great Britain imports large quantities of iron ore. Her home supplies, largely of haematite, come chiefly from Cumberland, the Furness district, Cleveland, Lincolnshire, and Northampton. France has large supplies of brown haematite in Lorraine, Longwy, Briey, and Nancy. Germany was second to the United States in iron production before the War, but her losses of Lorraine (75 per cent of her former supply) and Upper Silesia have reduced her to the fourth position. Her home production is now confined to the Siegerland, Lahn, and Dill areas, in the eastern block of the Rhine mountains, and the Peine-Salzgitter district, west of Brunswick. Sweden has vast resources of high-grade ores in the Gellivara and Dannemora districts. Russia has enormous quantities of good ore in the Urals, the Donetz coal-field, and elsewhere. Brown haematite is mined and exported in large quantities from northern Spain. Other regions of growing importance are : Styria (spathose), Algeria (red haematite), Canada (Michipicoten, Lake Superior), Newfoundland, Labrador, South Africa, China, Cuba, India, Japan, Mexico, Borneo, Australia, Elba, Poland, and Luxemburg (economic union with Belgium).

Coal. " Ordinary coal is a compact, stratified mass of dismembered ' mummified ' plants (which have decayed to varying degrees of completeness) free from all other matter, save for the mineral veins, partings, etc., which are local impurities, as are the quartz veins in a nugget of gold."—*Dr. M. C. Stopes.* Coal has been formed in two ways—either the giant club mosses, tree ferns, and other plants, growing luxuriantly in basin-like swamps under very favourable climatic and edaphic conditions, died down on the spot season after season, or generation after generation, until great deposits of vegetation had been formed ; or the plants were drifted into shallow lakes or lagoons, where they decayed slowly, forming a black slime or mud, which gradually filled up the lagoon. Sometimes, doubtless, these two processes were combined. Later, the vegetation was covered with sand or mud from river or sea, and thus the material of a coal seam was formed. The whole process was repeated many times until a succession of coal seams became enclosed or interbedded among a great thickness of aqueous deposits. Slowly, over great periods of time, the pressure, heat, folding, and faulting of the earth caused the vegetable accumulations to change into coal. Coal seams are generally overlain by water-bearing sandstone, and underlain by impervious slate or clay. They vary in thickness from a few inches to many feet, and are usually worth working when they are about 2 ft. or more in thickness and not very difficult of access.

Economically, coal may be divided into bituminous, cannel, and anthracite. Anthracite occurs where there has been much folding of the strata. It contains a very high proportion of carbon; burns with comparative difficulty, emitting very little smoke, and leaving very little ash; gives out great heat; and is very hard. For warships which burn coal it is very valuable on account of its smokeless nature and its great heat-giving property. The supplies of good anthracite are limited to certain regions, the best known being South Wales and Pennsylvania. Bituminous coal, ordinary burning coal, is softer, and contains less carbon but more coal-tar and gas than anthracite. It splits easily along the bedding planes, burns with a bright flame, and gives out gas and pitchy or bituminous matter. This kind of coal is used in the manufacture of coal-gas and coke, and the best grades for ship-bunkering. Cannel coal is dull, black, and hard, readily giving forth gas that burns with a bright, white flame. When luminous coal-gas was more in demand large quantities of it were used in gas-works. Lignite, or brown coal, is a poor form of coal, and has a relatively low percentage of carbon. It exhibits a woody appearance, yellow or brown in colour, due to imperfect carbonization. The newest coals, geologically speaking, are usually but not always lignitic. Its chief use is in gas production.

Developed coal resources measure largely, at present, the industrial supremacy of countries, and it is probable that coal will long remain the chief source of power. It is, therefore, of great importance to possess a knowledge of the world's coal resources. Coal measures are known to underlie more than 500,000 square miles of the earth's surface. Those of the carboniferous period are the most important as regards availability and quality, but the lower-grade and younger coals are of great local importance. The chief coal-producing countries are the United States (604,000,000 tons in the record year 1918 and annual average approximately 550,000,000 tons), Great Britain (250,000,000-280,000,000 tons annually), Germany (approximately 150,000,000), Poland (100,000,000), and France (approximately 45,000,000). The world production averages 1,300,000,000 to 1,500,000,000 tons. The coal resources of the United States are greater than those of the whole of Europe. Her annual supply of anthracite (88,000,000 tons) is obtained from one small field running south-westwards from Scranton, in eastern Pennsylvania. There are two large bituminous coal-fields: the Appalachian, which stretches almost without a break along the inner margin of the mountains, from Pennsylvania to Alabama, and the coal-field which underlies the prairies of Indiana and Illinois. The fields of the western plains and the Rockies are of inferior quality, and are mined mainly for local use. Great Britain leads in coal exportation, but has an important competitor in the United States. Coal is a prime factor in her industrial success and her great predominance in shipping. Her coal reserve, according to a recent estimate, is over 189,000,000,000 tons or about one-fiftieth of the world's reserve. Germany's leading coal-field is the Westphalian, lying in the Ruhr basin on the northern flank of the Rhine Mountains. She has lost the greater part of her upper Silesian coal-field to Poland, and the Saar coal-field to France (to be decided by plebiscite in 1933). Her minor fields are in Saxony, Lower Silesia, Aachen, and Bonn. The coal-fields of France are scattered. The most important is in the north-east (Lens). Smaller fields are those of Creusot, St. Etienne, Alais, Tarn, Vosges, Alps, Lorraine, and Saar. Outside Europe and the United States, Japan leads in output, reaching over 30,000,000 tons of inferior coal. The coal-fields are in Kiu-Shiu and Hokkaido, and there is an export of bunker coal. Other producing countries are China (vast ill-developed resources), Belgium, Australia, India, South Africa, Austria, Czecho-Slovakia, Spitzbergen, Russia, Canada, Chile, and Java. The deficiency of good coal in South America and Mediterranean Europe militates against their success in manufacturing industry. A hopeful feature for both the Empire and the

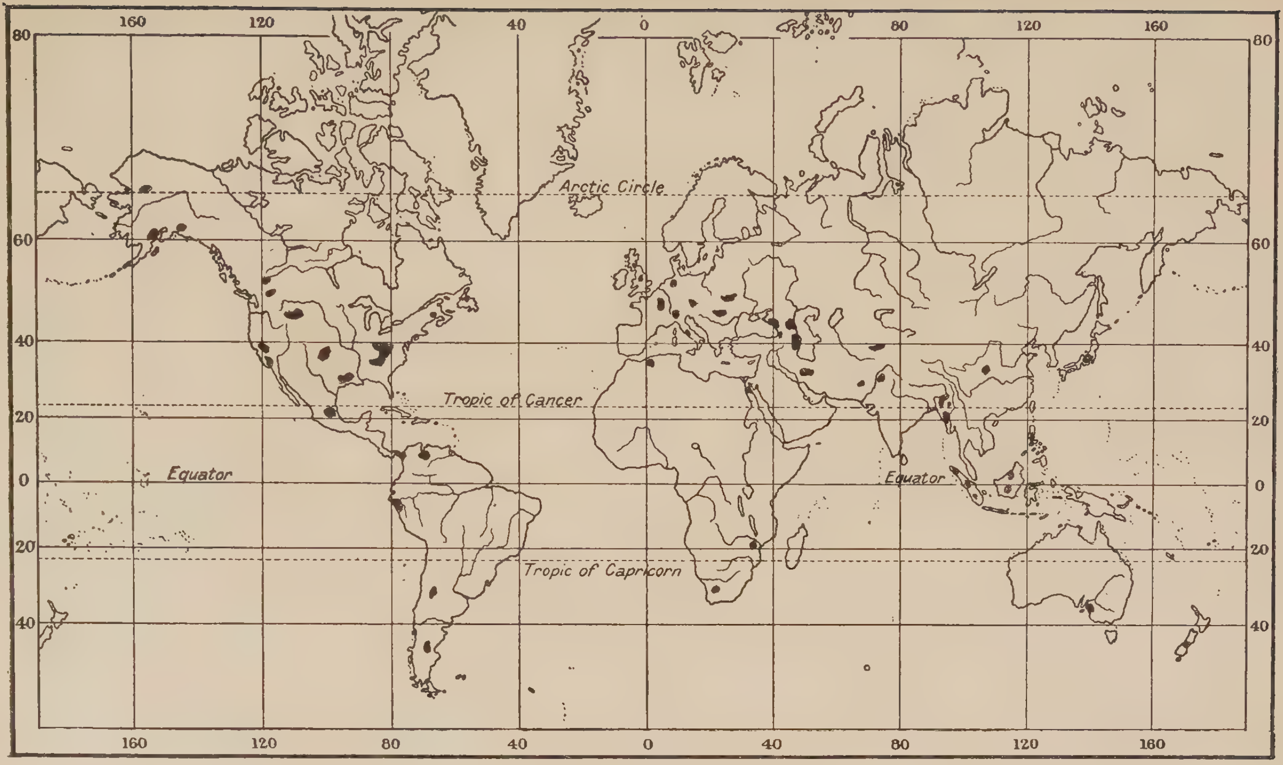


Distribution of Coal

Motherland is the vast reserve of coal in the Empire, recently estimated to be 470,000,000,000 tons.

PETROLEUM. A natural oil of wide occurrence, petroleum is usually found where the natural distillation products of vegetation are prevented from escape by an inverted basin of impermeable rock. It is generally concluded that it is the product of the natural destructive distillation of accumulations of organic remains, both vegetable and animal. The oil, or its derivatives, are used as lubricants, illuminants, or fuel. Petrol is of growing importance for power in motor engines, and kerosene for illuminating purposes, while the heavier oils are used as lubricants. Other products are benzine and benzol (solvents for fats and oils), paraffin wax used in candle-making, naphtha, and vaseline. British paraffin is obtained chiefly by the distillation of the Scottish bituminous shales. In America, petroleum is usually refined at the coast. Both here and in Russia the oil is piped to sea-ports, and shipped in "tankers," filled directly from the pipe line. The advantages of petroleum as a fuel in contrast to coal are its greater calorific power, more complete combustion, and greater convenience in storing.

The United States is supreme in the petroleum industry (over 60 per cent of the world's production). Her chief producing regions are California, Oklahoma, Texas, Ohio, Pennsylvania, Kansas, West Virginia, Indiana, and Illinois. Mexico normally takes third rank, but she has now surpassed Russia (Transcaucasia), formerly second in oil production. Her chief wells are very favourably placed near the Gulf of Mexico, behind the ports of Tampico, Port Lobos, and Tuxpan, and she has a secondary field in the Isthmus of Tehuantepec, behind Puerto Mexico. Transcaucasian supplies have recently decreased owing to the unsettled conditions existing. The most productive field is that of Baku and district (the Apsheron Peninsula) in Azerbaijan, and that of Grozny in the Terek Republic is important. Of growing importance are the oil-fields of central Java, of Palembang in southern Sumatra, and Langhat in the north of the island, and of Balik-Papan on the east coast of Borneo. Other sources of supply are Galicia (Poland), Rumania, Japan, Persia, Irak, India, Burma, Nigeria, Canada, Egypt, Trinidad, Barbados, Venezuela, Peru, and Colombia. Western Europe has few oil sources, and Britain's hopes of oil-wells have failed to materialize commercially.



Distribution of Petroleum

Natural Gas. This is the highest product of petroleum. When borings are made for oil natural gas is sometimes the first product obtained. It has a very high calorific power, and where it occurs it is a valuable fuel. In Pennsylvania, Ohio, and the adjacent states, the natural gas is conveyed in pipes to Pittsburg, Toledo, Cleveland, and other industrial centres for use as fuel.

Asphalt. A solid or nearly solid substance, black or brownish-black in colour, asphalt results from the thickening of petroleum through the absorption of oxygen. Its commonest commercial use is in paving, but it is also used as a roofing and waterproof material. The chief sources are the Val de Travers (Switzerland), Barbados, Trinidad (which contains the famous "Pitch Lake" of pure asphaltum), the Lake of Bermudez (Venezuela), and Cuba.

Copper. Used by man since prehistoric times, copper is, after iron, the most used metal. Mixed with zinc it produces brass; with tin or aluminium, bronze, and with nickel, German silver; but its chief importance is due to its extensive use as a conducting medium in the rapidly-growing electrical industries. It occurs naturally in large quantities in the Keeweenaw Peninsula in the south of Lake Superior, but is most abundant in the form of ores—oxides, carbonates or sulphides—spread in veins through rocks. Ores with less than 30 per cent of copper are mined. The United States produces more than half the world's total. Her ores are widely distributed through the Rocky Mountain belt (between longitude 110° and 120° W.), the greater output being in Arizona, followed by Montana, New Mexico, and Nevada. Next in rank are the favourably placed mines in Michigan. Mexico, the second producer, is far behind the United States, her chief mines being in Lower California (Boleo district) and in the Sierra Madre, in the State of Sonora. Other important producing regions are: Japan (on the west of Mainland and in Shikoku), Spain (two-thirds from the Rio Tinto district), Australia (South Australia, Queensland, New South Wales, and Tasmania), Chile, Canada (British Columbia and Ontario), Peru, Belgian Congo (Khatanga copper-field), Russia, Newfoundland, Germany (Harz Mountains), France (near Lyons), South Africa, Corea, Venezuela, and Cuba. Rich undeveloped supplies are in Alaska and Yunnan.

Tin. Very local in its distribution, tin occurs chiefly as cassiterite or tin oxide, although tin sulphide is also worked. Its chief use is in the manufacture of tin-plate, and of various alloys (bronze, gun-metal, pewter, white metal, and solder). In most cases tin ore occurs as grains and lumps in beds of gravel, so that all the work is done in the open air ; but, in Cornwall and Bolivia, the tin is found in veins in the rocks and mining is necessary. The chief supply comes from the Malay States and Straits Settlements, the Dutch East Indies (especially the islands of Banka and Billiton), and Bolivia. Other producing areas are Cornwall, Australia (Queensland, New South Wales, and Tasmania), Nigeria, the Transvaal, and China (Yunnan).

ZINC. A comparatively modern metal, the usefulness of zinc was not fully discovered until early in the nineteenth century. It is used for coating sheets of steel, and also wire, to prevent rust ; is indispensable in the manufacture of rubber ; and its oxide is used in paints. Zinc has been found native in Victoria ; but occurs almost exclusively in the combined state, as carbonate, sulphide, or oxide. The world's supply comes chiefly from the United States (Missouri, Kansas, Oklahoma, and Montana), German Silesia (Beuthen), Polish Silesia (Königshütte), and Australia (New South Wales and Tasmania). Small producers are Canada (British Columbia), France, Britain, Spain, Belgium, and Sardinia.

LEAD. This metal is obtained almost exclusively from galena (lead sulphide), lead carbonate and lead sulphate being only occasionally worked. It is used for water-pipes, cisterns, and roofing, and in the fittings of chemical works ; and alloys with tin to form solder and pewter, and with antimony in the production of type metal. Besides these uses, lead is the usual metal in the making of glass ; of its compounds, red-lead seals the joints of gas-pipes and water-pipes, while white lead is used in paints, and sugar of lead in dyeing and printing cotton. Silver is generally found in association with galena, and so makes many lead mines profitable to work. The United States leads in world production (40 per cent of the supply), the chief States being Montana, Nevada, Utah, Idaho, Missouri, and Colorado. Other producing regions are Spain (Cordoba), Germany (Harz Mountains, Saxony, and Silesia), Mexico, New South Wales (Broken Hill), Corea, and Great Britain.

ALUMINIUM. This metal, although the most plentiful of all the metallic constituents of the earth's crust, is a comparatively new commercial product. It combines lightness with great toughness and durability, and oxidizes only very slowly; hence its suitability for making surgical instruments, chemical apparatus, and cooking utensils. Its alloys (duralumin and tensalum), more tenacious than the pure metal, are used in the construction of torpedo-boats, air-ships, submarines, and motor-cars. Aluminium is obtained from various sources, but chiefly from clay, and of all clays which contain it, bauxite yields the largest quantities. The production of the metal is expensive. Commercially, it is always prepared electrolytically, and this has led to it being produced near waterfalls. Bauxite, after purification, is mixed with molten cryolite and then electrolyzed, when the melted aluminium sinks to the bottom of the vessel and is drawn off. Cryolite is found only at Ivigtut in south-west Greenland, but bauxite is found in small deposits in several places in the United States (Arkansas, Georgia, and Alabama), northern Ireland (Antrim), France (Arles), Germany, Italy, and Guiana. The chief countries producing aluminium are the United States, Switzerland, France, Scotland, Italy, Norway, and Canada.

ANTIMONY. This metal is found native in Borneo, but usually occurs as the sulphide (stibnite). On account of its brittleness it is not used alone, but its extreme hardness makes it a very useful component of alloys in combination with softer metals. With lead it forms shrapnel, with tin Britannia metal, and with tin and lead type-metal. The chief supplies come from China (the leading producing country), Algeria, Bolivia, French Indo-China, Mexico, Australia, Canada, and South Africa.

BISMUTH. Widely distributed, both alone and in sulphides and oxides, bismuth is used to give increased fusibility to various metallic alloys, and in the manufacture of certain colouring matters. Many of its compounds are used medicinally. The chief sources are Saxony, Carinthia, New South Wales, South Australia, Sweden, Bolivia, and Mexico.

MOLYBDENUM. This metal occurs chiefly in molybdenite (sulphide). The chief use of metallic molybdenum is for alloying with steel, which it makes very hard, and yet not so brittle as when tungsten is used. The chief sources are Canada (Ontario and Quebec), the United States (Arizona), Norway, and Australia.

TUNGSTEN. This metal is not found alone in nature, but always in combination with some of the other metals. It occurs principally in wolfram and schulite, and is an essential constituent of high-speed steels. The chief supplies are derived from Burma, Portugal, the United States, Australia (New South Wales, Queensland, Victoria, and Tasmania), Canada, China, and Cornwall.

NICKEL. The chief ores of nickel are its arsenide, its sulphide and sulph-arsenide, and magnesium nickel silicate. Nickel is used in toughening steel, in alloys, and for coating and plating other metals. The chief supplies come from Ontario (Sudbury), New Caledonia, and Norway.

MANGANESE. The chief ores of manganese are pyrolusite, braunite, hausmannite, and manganite. It is used in colouring pottery, in removing the yellowish tinge from glass, and in electric work; but its most important use is in hardening steel. Manganese steel has no magnetic power, hence its use in shipbuilding. The chief sources are India, Brazil, the United States, the Gold Coast, and Caucasia.

CHROMIUM. This metal is obtained almost entirely from chrome ironstone. Its chief use is in the production of hard steel for special purposes (tool steel, ferro-chrome, and stainless cutlery). Some of its salts are used in photography, dyeing, and tanning. The chief supplies come from Turkey, New Caledonia, Norway, Silesia, Czecho-Slovakia, France, the United States, and New South Wales.

VANADIUM. Used in the manufacture of hard steels, vanadium is obtained chiefly from Peru and the United States.

MAGNESIUM. Derived from its chief natural compounds, magnesite and dolomite, magnesium is used as an illuminant, and its salts are useful medicinally. Germany (Stassfurt) is the chief source.

ARSENIC. Arsenic is found in the elementary state, but more frequently combined. Its oxide was formerly used to give Scheele's green to wall-paper, and its compounds are used medicinally. Britain and Germany are large producers.

COBALT. Usually found in association with bismuth and nickel, cobalt was, until recently, chiefly valued because oxides of it were useful for colouring pottery and glass. It can be used, however, for many purposes in place of nickel, and will probably become of much greater importance. The chief supplies of cobalt ores come from Ontario (Sudbury) and New Caledonia.

Cadmium. A by-product in the manufacture of zinc, cadmium is chiefly used in alloys, and its sulphide as a colour in calico printing and for dyeing soaps.

Mercury. Quicksilver or mercury is the only metal in use which maintains a liquid state at ordinary temperatures. Its chief ore is cinnabar or mercuric sulphide. It is used in thermometers and barometers, in dentistry, and in the silvering of mirrors. The fact that it readily forms amalgams with other metals made it valuable in the past in the extraction of gold and silver from crushed rock, but it is now largely replaced by other processes. The chief sources of supply are Spain (Ciudad Real, Oviedo, and Almaden), Carniola (Idria), Texas, California (New Almaden), Russia, Mexico, Italy, Peru, Japan, China, and Bolivia.

Platinum. A rare metal, of higher value than gold, platinum is almost always found in the metallic state associated with varying quantities of iron, iridium, osmium, and palladium. It is widely distributed in the older rocks, but in such small quantities that practically the only source of supply is from alluvial deposits. Platinum is an exceedingly hard metal, very resistant to air, acids, and high temperatures, and so it is of high value in scientific work and in jewellery manufacture. The chief placer deposits of the metal are in the Urals (Nizhni, Tagdsk, and Bogoslowsk), Colombia (Choco and Barbarcoas), Siberia, Canada (Ontario), and the United States (California and Oregon).

Silver. Like gold, silver has been known since the very earliest times, and is found both in the native state and in many ores. Lead, copper, gold, zinc, arsenic, cobalt, and antimony ores often contain silver, the desilverization of which furnishes the great bulk of the world's output of the metal. It is used in jewellery, for coinage purposes, for plating base metals, and for scientific apparatus. Its high price leads to mining in relatively inaccessible districts, and lured the Spaniards into Central America. The chief producers of silver are the United States and Mexico, which together yield over 70 per cent of the world's supply. In Mexico the mines are on the high plateau, especially in the south, and in the United States chiefly in the Rockies and the Great Basin region of the west

(Nevada, Colorado, and Montana). Other silver producers are Australia (Broken Hill in New South Wales), Canada (Ontario and British Columbia), Peru, Bolivia, Germany, Spain, and Japan.

GOLD. This precious metal occurs usually in the native state in the quartz veins of the metamorphic, igneous, and older sedimentary rocks. It is also obtained from placer deposits in alluvial soils, which have originated from the degradation of the gold-bearing rocks. Gold is widely distributed, but rich deposits of considerable extent are rare. Placer deposits are the usual material for the small scale mining, which needs little skill, capital, and labour. Quartz crushing needs expensive machinery and much labour, and represents a later stage in gold mining. Gold is one of the heaviest of metals, is extraordinarily malleable and ductile, and does not tarnish on exposure to the air. In consequence of its softness it is not used pure for ornaments or coins, a certain amount of copper or some other metal being used with it to harden it. The Transvaal leads in the production of gold (42 per cent), followed by the United States (21 per cent, Colorado, Alaska, California, Nevada, Dakota, Montana, Arizona, and Utah), and Australia (12 per cent, West Australia, Victoria, Queensland, New South Wales, and Tasmania). Other producers are Canada (Ontario, Klondike, and British Columbia), India (Mysore), Rhodesia, the Gold Coast, British Guiana, European Russia, Siberia, Mexico, and Transylvania (Rumania).

RADIUM. Radium is present in many minerals, but particularly in the pitch blende (uranium oxide) of Joachimsthal (north-west Bohemia, Czecho-Slovakia). Although an element, it seems to be produced by the decomposition of uranium ; and, as there is no known means of expediting that change, radium remains very rare. Its commercial value lies in its rays, which have a pronounced effect on certain malignant growths.

SALT. This mineral is widely distributed, but does not enter much into international commerce. It exists naturally either in the massive crystalline condition (rock salt), in solution, or in small crystal deposits (Colorado). The chief producing countries are the United States, Great Britain, India, Germany, Russia, France, Spain, Austria, Poland, Italy, and Portugal.

GRAPHITE. Plumbago, blacklead or graphite is a form of carbon, and is chemically identical with the diamond. It is found in igneous rocks and altered limestones, and is widely used in the manufacture of crucibles, lubricants, polish, and lead pencils. For crucibles used in the electric furnace graphite is now made artificially, especially at Kinlochleven and the Niagara Falls, by heating coke, first ground up with tar or treacle, in the electric furnace, when the coke becomes crystalline. The chief producers of natural graphite are Austria, Ceylon, Bavaria, Italy, Mexico, the United States, Canada, Indo-China, and Siberia. Borrowdale (Cumberland) formerly produced large quantities, but the mines are now practically exhausted.

SULPHUR. Sulphur is found in a native state wherever volcanic activity is manifest, and is derived also from iron pyrites (sulphide). It is used in the preparation of sulphur dioxide and sulphuric acid, in the manufacture of gunpowder, in making india-rubber from caoutchouc, in vulcanizing, and in the manufacture of matches. Native sulphur is mined principally in the United States (Louisiana, Utah, and Wyoming), Sicily, Japan (Etrofu), Italy, Iceland, Spain, and New Zealand. Pyrites are mined chiefly in Spain, the United States, Italy, Norway, Canada, France, Portugal, Japan, and Hungary. Sulphur ore, when mined, usually contains up to 25 per cent of sulphur.

GYPSUM. A hydrated sulphate of calcium, gypsum is used as a fertilizer, and in the manufacture of certain kinds of paper. It occurs among the more recent clays and marls. The chief producing countries are the United States, France, Canada, England (Nottingham, Cumberland, and Sussex). Burnt to expel the water, gypsum produces plaster of Paris.

ASBESTOS. Asbestos is a name somewhat loosely applied to a number of minerals which can be obtained in a fibrous condition, but in commerce the term is chiefly confined to "tremolite" asbestos, or Italian asbestos, from the Piedmont Alps, and to "serpentine" asbestos from Quebec. The mineral owes its fibrous character to the enormous length of its crystals, which are readily separable. Because of its resistance to fire and low power of heat conduction it is used in gas stoves, for the making of fire-proof curtains, as a packing for cylinders, and as a heat insulating covering for steam-boilers and pipes. Most asbestos comes from Canada (Quebec), South Africa (the Transvaal), Russia (Urals), and Italy.

PHOSPHATES. These are important fertilizers. Rocks containing phosphates are widely distributed, but deposits containing less than 50 per cent of phosphate are rarely worked. The chief producers are the United States (Florida), Tunis, Algeria, France, Belgium, and the Pacific Islands—Christmas, Ocean, and Nauru.

GUANO. A rich fertilizer, guano consists of the excrement of sea birds, with residues of uneaten food, and the skeletons of the gulls themselves. It is now mainly obtained from the west coast of Chile and the Chincha Isles (Peru).

SODIUM NITRATE. Chili saltpetre, or sodium nitrate, is used both as a manure and in the arts. It is found in huge deposits some 3,000 to 4,000 ft. above sea-level in the rainless Atacama desert of Chile. Calcium nitrate, an efficient substitute, is now produced, by the fixation of atmospheric nitrogen, in Germany and Norway.

POTASH MANURES. Supplies of potassium compounds, which can be easily worked, are extremely localized, and those of Stassfurt (Germany) and of Alsace are the only ones of importance to commerce.

BASIC SLAG. A manure of slow action, basic slag is the refuse of the basic process of steel-making.

MONAZITE. This contains thorium and cerium used in the making of incandescent mantles. It is obtained from ancient rocks in India (Travancore) and Brazil.

PRECIOUS STONES. Markedly regional in their distribution, like silver and gold, precious stones attract population and stimulate commercial activity. The *diamond* is a very valuable crystalline form of carbon. Most of the world's supply of diamonds comes from South Africa. The mines of Kimberley can produce all the world is willing to pay for at the present time. The diamonds are found in the " pipes " of extinct volcanoes embedded in a blue rock or clay, and need much labour and capital for their exploitation. Diamonds are also obtained from Brazil, India, New South Wales, and British Guiana. *Corundum* is a very hard substance, found in greenish-grey granules in Ceylon, and as stratum in Massachusetts and in North Carolina. When found admixed with iron oxide it is called *emery* (United States, Greece, and Asia Minor). Both corundum and emery are used as abrasives for grinding and polishing. The *ruby* and *sapphire*, impure and crystalline varieties of corundum, are beautiful, rare, and highly valued. They are found chiefly in Ceylon, Burma, and Siam. Mogok, in Upper Burma, is the chief source of *rubies*. Other precious stones are *garnets* (Saxony, Bohemia, Burma, Ceylon, and the Urals) ; *emeralds* (Colombia, Siberia, and New South Wales) ; *topazes* (Brazil and the Urals); *agates* (Germany and Brazil) ; *tourmalines* (Ceylon, Siberia, and the United States) ; *opals* (Queensland, Hungary, and Saxony) ; *jet* (North Germany, France, and England) ; *amber* (Baltic shores) ; and *pearls* (Gulf of Manaar, Bahrein Island, Sulu Islands, Gulf of California, and off the north and west coasts of Australia).

Rocks of Economic Value. Many rocks are used for building-stones, others for ornamental purposes, and some for paving-stones and road metals.

SANDSTONES AND GRITS. Widely spread, durable, easily cut and trimmed, sandstones and grits are, perhaps, the most largely used of all building-stones. Of the British sandstones and grits those most used for building purposes are the Torridon sandstone of north-west Scotland, the Craigleith sandstone quarried near Edinburgh, the Pennant grit of the Forest of Dean, the Old Red sandstone of Herefordshire, and the sandstone and grits of the Pennines. The millstone grit is much used for road metal, and for millstones. *Gannister*, a form of sandstone, is used for furnace linings.

LIMESTONES. These are frequently used for building purposes. The oolitic British limestones furnish most valuable and famous building-stones. The freestones of Portland, Bath, Ketton, Stamford, and Ancaster are excellent ; and so is the Red Mansfield stone.

SLATES. Formed from clays by great pressure, slates are usually found in the older rock systems. They are quarried in Wales, Scotland, Ireland, the United States, Austria, France, and Canada.

CLAYS AND SHALES. These are used for making bricks.

GRANITE. This is the most important plutonic building-stone. The chief supplies come from England, Scotland, the United States, Sweden, Norway, Germany, France, and Canada.

MARBLE. This stone is metamorphosed calcium carbonate. The finest statuary and building marble is obtained from Carrara (Tuscany).

(*b*) **MANUFACTURES.**—Manufacturing industries are those which work up raw materials with the object of converting them into goods of a higher value by processes of separation, combination, or transformation. They include all work of adapting raw materials for the use of mankind, irrespective of whether hand-labour or machinery is employed. Manufactures started in the production at home of articles for the use of the family; but gradually man came to recognize the advantages of the division of labour. The history of manufacture is best surveyed as the ever-widening application of the division of labour—the allocation of special tasks to particular sets of people. From the individual standpoint the division of labour means specialization; from society's standpoint it signifies co-operation. The individual specializes because, by restricting his work to a single trade or a single process, he becomes more efficient at his particular work than would otherwise be the case were his work more varied. In a complex industrial society like that of Britain, every producer is a specialist in detail, because the society includes specialists in every other kind of work needed to satisfy its wants. Specialization by individuals was at first confined to single industries or trades; then followed the sub-division of one specialized craft into separate processes and the specialization of "detail" workers to each of these processes. Thus the manufacture of cloth has become the work of spinners, weavers, fullers, dyers, and finishers, each of whom works at a single process with a specialized tool. Sub-division of processes led to improvements in tools, and, finally, to the invention of machinery, the application of which to industry has resulted in the further specialization of human workers and the production of masses of goods. When mechanical power was applied in industry, factories arose, containing many machines and employing regiments of human workers. It was the application of non-human power to machinery in several important industries that brought the Industrial Revolution in the last decades of the eighteenth century. The growth of subsidiary industries, which supply the staple industries with their machinery and incidental requirements of manufacture and sometimes utilize their by-products, represents further specialization. The textile districts fix the location of the manufacture of textile machinery, the dyeing and finishing trades, and the chemical and dry-salting trades. One of the most important economies of modern industry is the complete utilization of by-products which become possible when a localized industry makes a large bulk available without transport charges. Science can find an industrial use for most things, provided that they can be had in sufficient quantity at a cheap rate.

Specialization. It is possible for specialization to take place within the firm or within the trade. The tendency during the greater part of last century was for individual firms to devote themselves more and more exclusively to a single process or a small group of related processes. To-day, the tendency in many trades is to unify under one management all the processes in the manufacture of a given product. In the heavy steel industry, the making of the ore, the different processes of the manufacture of steel, and the construction of ships, bridges, and other heavy steel goods are frequently carried on by the same management because of the technical economies possible. Where, however, the unit of product is small and the processes of its manufacture are comparatively simple, as in the Yorkshire woollen industry, the different processes—combing, spinning, weaving, dyeing, and finishing—are usually undertaken by separate firms. The highest form of specialization in manufactures is exhibited by the Lancashire cotton industry. Spinning, favoured by the muggy air, is carried on in Oldham, Ashton, Stockport, Bolton, and Rochdale; while the weaving centres include the Ribble group of towns—Preston, Blackburn, Darwen, Accrington, Burnley, Nelson, and Colne—and the Irwell group—Radcliffe, Bury, Heywood, Haslingden, Bacup, and Rawtenstall—where the damp atmosphere is not so pronounced. Further specialization is seen in the different branches. Bolton spins the fine counts and Egyptian yarn, Oldham the coarser yarn; Blackburn is famous for dhooties, India and China goods; Burnley for cloth for printing; Nelson for sateens; Haslingden for sheetings; while Manchester is the specialized market. The twentieth century is noteworthy for the formation of large industrial groups by which a large number of interdependent industries have been brought under a single management. Groups, having as their object the production, working-up, and marketing of iron and metals, chemical and metallurgical products, have obtained controlling interests in coal mines, iron-ore deposits, chemical works, iron works, and transport industries, thus effecting great savings.

Sources of Power. The influences which have caused the localization of various manufactures can be discovered only by studying their history; but three factors are usually predominant—cheap power, accessibility to raw materials, and accessibility to markets. A nation's economic greatness may be measured by the amount of energy it possesses and the use it makes of that energy, and the history of manufactures is the story of man's increasing ability to control energy. At first, all manufactures were carried on slowly and laboriously by hand-power at a number of small centres. The next stage began when water-power was used to drive machinery. Manufacturing populations then began to gather near to running water, and wild valleys became hives of industry. The substitution of steam for water-power attracted manufactures to the coalfields, which are still the great industrial centres of the world. Electricity, a new means of making available already existing sources of energy in falling water and in fuel, is attracting some industries back to the water-power regions, and may help to make future industrial centres more pleasing to man's higher faculties. Energy is constant; but in the forms available for man's life it may disappear.. Coal and oil, the slowly accumulated savings of radiant energy poured on to the earth during countless thousands of years, are strictly limited in amount, and will soon be exhausted as the universe measures time. Man is, therefore, looking more and more to other sources of available energy, and exploring the constitution of the world more deeply to be able to recover both energy and matter for his ultimate security and greater use. It may be that with greater control over nature he will utilize fully the abundant energy of radio-active bodies such as radium; the heat stored up in the earth's interior; the sun's light and heat now so largely unemployed; the force of gravity, which moves the incalculable masses of the water of the world in tides and waterfalls and rivers; the reservoirs of force in the atom, which stagger his imagination; the energy in all plant-life, which ensures no want of power while this old world is green; and the almost untouched energy of wind. Changes in man's distribution and habits will inevitably follow his mastery of these new sources of power.

Raw Materials. Carnegie says : " The seat of manufacturing is now, and will continue to be more and more, simply a question where the requisite materials are found under suitable conditions. Capital and labour have lost the power they once had to attract raw materials ; these now attract labour and capital." In "new" countries not yet effectively controlled by advanced western people, and in simple societies the seats of manufacture are usually determined by the presence of raw material. Thus, Canadian manufactures are connected with timber and agriculture, and those of the central Asiatic peoples are dependent on the pastoral industry. In advanced societies the proximity to the raw materials may fix the location of a manufacture as in the case of wine in the vine-growing regions of France, but is only essential when the raw product plays a specially important part as compared with labour and capital, or when the raw materials are heavy and necessitate large expenses of transport. Brick-making needs the proximity to clay, and the manufacture of steel is strongly localized on those coal-fields which have ore deposits adjacent or can easily import foreign ores. The more developed a manufacturing concern becomes, the more easily will it flourish independently of the local supplies of raw material. Raw material, however, must be always readily accessible. Lancashire can easily obtain its raw cotton ; Yorkshire its wool ; while the flour-milling industry in Britain, formerly distributed as widely as the growing of corn, now draws its main supply from foreign sources, and tends to concentrate at the great ports.

Access to Markets. Ready access to markets, home or foreign, determines the size of industries and may localize them. Division of labour with all its economies, inventions, and increased output is limited by the extent of the market, and hence manufactures have gained breadth and power as they have widened their markets. The advantages to be derived from a local market have caused capital cities to become the homes of miscellaneous industries of all grades, and especially of the highest grades. London, Berlin, Paris, and New York have numerous manufactures, and in them are localized the manufactures of musical and scientific instruments, artistic furniture, fine machinery, and jewellery, all of which demand much wealth and much alertness, and find a critical but generous demand from the wealthy citizens.

Labour Supply. Human labour and skill and organizing ability are important factors in the development of manufactures. In "new" countries and the conservative East, the scarcity of skilled factory labour accounts for the infancy or the slow growth of their manufactures; while the presence of abundant labour of the highest quality explains the predominance of Lancashire cottons and Sheffield steel. The influence of organizing ability and genius is seen in the growth of the pottery industry of Staffordshire, the shoe-making industry of Lynn (U.S.A.), and the electrical industries of Berlin. Cheap labour has an attraction for industry similar to cheap power; the low-grade industries which congregate in the East of London are based on the cheap labour of the wives and children of the dockers, and on that of a peculiar class of keen and alert workers, who deeply appreciate the excitements of London life, and do light monotonous work cheaply, quickly, and well. The existence of available supplies of capital in the immediate locality in which a manufacture is carried on is one of the most important conditions of its success. Lack of capital has limited the growth of manufactures in Russia and the Balkan lands; whereas the vast accumulations of savings in the manufacturing districts of the United States, Britain, Germany, and France have been powerful agents in their industrial development.

Local Factors. Sometimes local causes locate particular manufactures. The pure water of the streams in the neighbourhood of Edinburgh and Maidstone favours the paper industry in those towns; the air of Ulster contains the right amount of moisture for the successful manufacture of linen, while that of Lancashire is ideal for high-grade cotton goods; the water of the Tay at Perth is particularly suitable for dyeing, while that of the Lys, in Belgium, is very favourable for bleaching; and the dry air of Buda-Pesth is ideal for flour-milling.

Importance of Iron and Steel. Iron and steel are the great savers of time, the chief engines of thorough solid work, and the chief material of the subtle and powerful machines and instruments of modern manufactures. Consequently, countries possessing abundant iron ore and ability to use it are placed advantageously for manufacturing. Until the last decades of the eighteenth century, English iron industries used charcoal for smelting, and were to be found in the neighbourhood of oak forests ; later, they sought to be near coal supplies, the heaviest of their raw materials, and to rich veins of ore. Recently, however, successive economies in the consumption of coal have lessened the importance of near access to coal mines, relatively to those of easy access to iron ore and to markets for the finished products. Consequently, the heavy British steel industries tend to move to the sea-coast, or the lower reaches of deep rivers, to which regions iron-ore can be imported easily, and from which the finished product can be exported conveniently either as ship's cargo or part of the ship itself. In the United States, the general rule is that iron-ore is conveyed for working to the locality of coal. Thus, the excellent coke of West Pennsylvania holds the American steel industries on a long rope. It remains to be seen whether an industry can be maintained in a district when both its iron and coal shall fail.

Combined Advantages. A manufacturing region rarely, if ever, owes its origin and growth to one favourable factor, but usually to a combination of advantages. The iron and steel industries of Cleveland, on Lake Erie, have easy access to the coal of Pennsylvania, the iron ore of Lake Superior, and lime from islands in Lake Erie, and transport facilities by lake and railway are excellent. The Yorkshire woollen industry has the advantages of accessibility to its raw material, a plentiful water supply, local coal and iron, highly-skilled labour, and excellent communications. Once an industry is established in a region, several circumstances tend to retain it in that place, even when some of its former favourable geographic factors have lost their power. It may be that labourers with inherited skill and intimate knowledge of the business have created an industrial " atmosphere " ; that a considerable amount of capital has been invested in the form of buildings, technical appliances, and the acquirement of a large circle of customers ; and that transport arrangements have been made. These factors will help the industry against competitors, and it may, therefore, survive by " geographical inertia " as in the case of the tin-smelting industry of Swansea, and the biscuit industry of Reading.

Political Interference. Political considerations may aid, hinder, or prevent manufacturing industries. The far-seeing Government of Germany, in encouraging technical education and financially assisting industry, facilitated the growth of her chemical and spelter industries. Industry cannot flourish without security and stability of government; and the political unrest in South America, the defective government of Turkey, the insecure conditions in Bolshevik Russia, and the conservative government of China, have been instrumental in keeping back capital from industrial and commercial enterprises in those regions.

Chief Manufacturing Countries. The great manufacturing countries of the world are the United States, Great Britain, Germany, and France; lands blessed with temperate climates and frequent small changes of temperature, where man is most energetic and possesses the strength and desire to work and to achieve. Massive production, the creation of steam-power and railways, is characteristic of all four countries; but each shows distinctive features in its manufactures. The British manufacturer has a high reputation for fair dealing, and for goods of superior quality and durability. Britain had the advantage of an early start, and is conservative in adopting new methods; but the British characteristics of firm will, self-determination, thoroughness, fidelity, and love of freedom are highly suited to capitalistic and massive production of goods of solid comfort and strength. France has been the meeting-place of the best energy of the North with the best culture of the South, and the artistic sense is strong in her artisans. She specializes in textile and metallic work that call for individual taste and thought as regards form, arrangement, and colour. With increased home supplies of coal and iron, she is recovering from her terrible losses during the War. Germany has been the leader in the application of science to massive production; no country, as yet, can compare with her in the organized work of detail, by which epoch-making thoughts are brought to bear on practice in such a way as to make an epoch industry. She is pre-eminent in the chemical and dyestuffs industry, her large supplies of potash and other salts and the by-products of her coking-ovens together with scientific labour giving her the advantage. German skill, energy, and organizing power will help her to retain her leading position. Manufacturing methods in the United States make for the production of business plant and of products for immediate consumption in endless variety of standardized forms. The varied immigrant peoples from many types of environment, the huge home supplies of raw material, the great capital, and the organizing powers of American directors are prime factors assuring the United States of a still greater future. In the lands of the Far East, lands of patient races, goods are manufactured by hand with a care and skill which gives them great beauty and desirability. China is noted for its silks, embroidery, and pottery; Japan for beautiful textiles and pictures, lacquer, pottery, and bric-à-brac; India for finely carved ivory, rich inlays, brass-work, and fine textiles. Western nations, less idealistic and less patient, show survivals of domestic manufactures in certain sparsely populated regions; but specialization and massive production tend to kill craftsmanship and keen interest in the finished product. Individuality is the essence of art—a beautiful thing bears the impress of its maker's personality. Nations must decide where to draw the line between mechanical reproduction and the production of original artistic work by their artisans. The great inventions have given the West its undisputed material primacy, and there is evidence that, with a mastery of the science of living things, western civilization will seek the beautiful and the ideal more and more.

Powerful industrial countries are not the only contributors of those ideas which have made for industrial progress. Belgium, Switzerland, Italy, Scandinavia, and other minor countries have contributed; but future success in manufactures (mass production) seems likely to be with countries which possess great size, large accumulated capital, and rich natural resources. These will enable them to concentrate large and highly organized mental powers and material appliances in putting into practice the architectonic ideas of the scientific research worker and the inventor. Australia and Canada are well endowed with natural resources, and have alert populations; but suffer from lack of compactness, a disadvantageous factor in massive production. Should the genius of invention overcome the hindrance arising from this defect their prospects as future leaders in manufacture are good. Japan, with rich mineral resources and excellent position for trade, promises to become a "manufacturing Britain." Her directing and managerial classes and clerical workers equal those of Europe, but her workers are badly educated and often ignorant of machinery.

Her people, however, have learnt much from the West during the last fifty years ; they possess singular powers of self-abnegation and high enterprise ; they are patriotic and artistic ; and with a stronger diet will be able to sustain continuous, severe, physical strain. India suffers from lack of coal, a climate not so conducive to energy as that of temperate lands, and difficulties of transport. Yet she has given to the world some of the greatest thoughts, and originated some of the subtlest and most artistic manual industries. The electrical energy to be derived from the water-power of the Himalayan slopes, her patient and numerous workers, her vast home market, and the idealistic spirit of her thinkers, should assure future progress. Russia and China, homogeneous and self-contained, blessed with numerous resources and with peoples endowed with great powers of endurance, should, given stable governments and greater development of transport facilities, attain leadership in industry in the future.

The organization and closer union which have resulted from the application of science to industry and life are beginning to express themselves in a fuller and nobler life on the part of all the individuals enmeshed in the system. There is excellent promise that the environment of the future industrial worker will be one which will not only give him greater material comforts, but will also develop his spiritual side. Social responsibility is being felt more ; machinery and the utilization of natural powers are relieving the manual worker ; the masses are being given opportunities to develop their higher faculties ; and the more profound is becoming the awe with which man regards the Divine Governance of the Universe.

Sources of Power. HAND LABOUR. From the early ages to the Industrial Revolution human energy was, with animal power, the chief source of power, and manufactures, except on a domestic scale, were impossible. To-day, hand labour is employed in Eastern lands, the steppe regions, and in a few districts of the old developed lands ; but the competition of machine-made goods tends to drive domestic manufactures out of existence.

ANIMAL POWER. Man early obtained the assistance of animals for transport purposes, and the cultivation of his fields ; and horses and oxen are still largely used for these purposes, especially in the progressive countries.

WIND POWER. Wind was one of the earliest forms of mechanical power. Its use in the wind-driven ship and the corn-grinding windmill effected enormous saving in human energy and capital. The steady trade winds are almost ideal for wind-power, but windmills are used largely only in temperate open lands to pump water, and to cut wood and fodder. The sailing ship has greatly declined ; and, until the invention of a cheap storage battery which will enable the power of high winds to be saved for times when there is no wind, the intermittent nature of this source of power in many regions will prevent it from becoming important commercially.

WATER POWER. Water furnishes the cheapest kind of power, and like wind was early used in manufactures. Where streams flowed all the year round in industrial areas of rugged relief, water power was the means of driving the machinery in the manufacture of textiles and of cutlery before the era of steam. To-day, it operates the saw-mills in the timber lands of Canada, Norway, Sweden, and Finland.

ELECTRICITY AND WATER POWER. The application of electricity to industry, and the discovery of hydro-electric methods of transmitting power for some distance, have resulted in a new phase of water-power utilization. Manufactures have been, and are being established in regions well supplied with water power which could not previously compete with steam for quickly-working machinery. Rugged countries well supplied with water, the high rainy regions of the world, and the once glaciated regions where the rivers have numerous rapids, are tending to rival coal-fields as industrial centres. Britain utilizes falling water at Kinlochleven (Scotland) and in North Wales, and will probably eventually master the tidal energy in the Severn ; coalless Norway derives electricity from her waterfalls to manufacture calcium carbide, nitrogenous manures, and wood-pulp, and to run her northern railways ; Switzerland employs electric power in the bulk of her manufactures, and her rail transport ; and the glaciated regions of eastern Canada and New England are making much use of their lakes, falls, and rapids. When the transport of power on a large scale over long distances becomes a reality, several countries which now import coal and oil will be among the chief power-producers, and their site values will be greatly changed. Among the countries favoured with abundant perennial flowing water are the United States, France, Norway, Sweden, Austria, Italy, Czecho-Slovakia, Spain, Switzerland, southern Germany, India, South Africa, China, Japan, Brazil, British Columbia, and New Zealand. Britain, unfortunately, possesses very little available water power apart from the tides.

TIMBER. The use of wood for purposes of power has greatly declined. It is still used as fuel on the Finnish, Russian, and Swedish railways and on river boats in little developed or coalless countries. In Sweden, in the form of charcoal, it is employed to smelt iron ores, but industries dependent on it must be near the source of supply, because of its costly transport.

ALCOHOL. As a source of power, alcohol is growing in importance, and as it can be produced from an endless number of vegetable materials its sources of supply are ever present and inexhaustible. The equatorial forests may, in the future, be exploited as the great source of alcohol.

COAL AND PETROLEUM. These minerals show signs of exhaustion in several lands, and the only permanent sources of power now used are running water, plant-life, and wind. When sun-power, atomic power, and tidal energy can be obtained directly and cheaply one of the world's greatest problems will be solved.

Manufactures and Manufacturing Regions. TEXTILES. Textiles are woven goods, made up of warp and weft of various kinds—wool, cotton, linen, jute, hemp, ramie, silk, asbestos, and "artificial silk." Of all these materials cotton is easily chief.

COTTON MANUFACTURES AND MANUFACTURING REGIONS. A cotton fibre resembles a collapsed rubber tube with an uneven wavy exterior, and it is upon this property that the special suitability of cotton for spinning purposes depends. In all textile industries two processes are involved: the spinning of the fibres into thread or yarn, and the weaving of the warp and weft threads into cloth. Warp threads are stretched lengthwise in the loom, while the weft is across the machine and the cloth. It is important that yarn should be of uniform thickness and strength, and this strength must be known. The most difficult part of textile manufactures is the spinning of warp yarns, and the difficulty obviously increases with the demand for the thin yarns for fine cloth. To obtain fine cotton yarns, natural or, less preferably, artificial damping of the fibres is necessary, and it is largely on account of its consistently damp atmosphere that Lancashire leads the world in the production of fine " counts." The quality of fineness is indicated by means of figures called " counts." The smaller the figure the coarser the yarn. Thus, " forties " means forty hanks to the pound, while " eighties " means eighty hanks to the pound.

The first operation in cotton manufacture is to reduce the bales of cotton (400 to 500 lb. each) to a fluffy, open, workable condition. The cotton is first passed over heavily-spiked rollers which break it up, and then over another series of spiked rollers which receive cotton of different though similar grades, work them together, and loosen the mass. Next, the lint is freed of impurities by removal to an " opening machine," where it is rolled between fluted and perforated rollers into sheets, the process afterwards being repeated in a " scutching machine." The matted cotton fibre is now ready to be " carded," a process which consists essentially of combing the cotton between very small wire-toothed rollers, laying the fibres roughly parallel to each other, bringing them together, and delivering them as a continuous ribbon-like piece called a " sliver." The sliver is round, thick, soft, untwisted, and delicate, and needs to be made thinner, straighter, longer, and stronger before usage by the weaver.

For fine cotton, the slivers are drawn through a " combing " machine, but for coarser work the further combing may be dispensed with. In each machine there are many successive combs with progressively finer-set teeth, which not only straighten out the fibres to a more parallel condition, but also reject the short fibres. All slivers, whether combed or not, are drawn, and this operation consists in taking a number of them and drawing them out continuously into one of greater length. The drawing is effected by rollers revolving at different speeds.

Twisting of the fibres is done in successive stages. The machine, called the " slubber," draws out the slivers still further, and then delivers them on to a rotating bobbin, thus giving some twist. Other machines draw the " slivers," or " rovings " together, and twist them still more, until eventually they are ready for spinning into yarn. There are two main types of spinning—continuous, by the Ring-spinning machine, and " intermittent," by the mule. The

Ring-spinner further draws out the thread between rollers, and then delivers it via a rotating ring on to a spool on a spindle which is rotating at a much faster rate. The result is a much-twisted finished thread. To-day, the best spinning machines can spin a cotton so fine that it takes 350 hanks to weigh a pound.

Weaving is carried on, nowadays, by power looms. In the looms long, special, and sized warp threads are paid out from bobbins on the weaver's beam, and are crossed by weft threads at right angles. For simple weaving every alternate warp thread is depressed and the others raised in order to make a "shed" through which the shuttle holding the weft thread travels to return again through another shed. Each successive weft is pushed hard into place by a slye, and the cloth, when completed, is wound on to a roller. In more expensive and figured work the manufacture is much more complicated, and needs very elaborate devices.

Yarns are often dyed, and warps sometimes printed, before weaving. Usually, however, after weaving, the fabric or "grey cloth" goes through one or all of the processes of bleaching, dyeing, and printing. These three processes are dependent upon plentiful supplies of pure water, and the factories are to be found in the upper courses of rivers. In earlier times bleaching was effected by the action of sunlight on the cloth, which was moistened with alkali and spread on the grass. Nowadays, in the print works, the cloth has its size removed, is passed over heated rollers to remove its nap, and is then prepared for dyeing or for printing, or for both. In roller printing, the fabric is passed continuously over a huge cylinder, and revolving in contact with it are a number of small copper cylinders, each of which runs in a bath of colour stuff and is engraved with that portion of the pattern which is to be represented in that particular colour. As cotton is practically pure cellulose it does not combine chemically with most dyes, and, except for the recently introduced substantive cotton dyes and indigo, mordants such as tannins, lead and aluminium salts, which will combine at once with the dye and the cotton, are used. Mercerized cotton, which has a silky finish, is produced by soaking the tightly-stretched fabric in strong soda solution.

The British cotton industry is the greatest, most complex, most highly organized, and most specialized of all manufacturing industries. ~~It is almost~~ entirely located on the western slopes of the Pennines, mainly in Lancashire south of the Ribble, and the adjoining parts of Yorkshire, Derbyshire, and Cheshire; Glasgow, Paisley, Nottingham, and Long Eaton are secondary centres. The total number of spindles is estimated at 61,000,000 (over 40 per cent of the world's total), one-third of which are engaged in spinning the finer counts. Over 200,000 operatives are occupied in spinning, and, in addition, there are 800,000 looms employing over 350,000 weavers. Every variety of cotton textiles is ~~manufactured~~, from coarse sheetings to chiffons and voiles, and it is only ~~in the~~ manufacture of hosiery and gloves that the British manufacturer fails to lead. Probably, 500,000,000 people are clothed in Lancashire cottons. Cotton leads in textile manufactures ~~in the United States~~. There are approximately 38,000,000 spindles, and 750,000 looms. The manufacture is concentrated in the region east of the Appalachians, in a long belt from Maine to Alabama, with its greatest centres in New England and at the eastern base of the Appalachians in the Carolinas and Georgia, with a lesser centre in Philadelphia. Fall River, New Bedford, Pawtucket, Manchester, Lowell, and Lawrence are among the leading towns. The cotton products of the United States lack the high finish of the British, and find their foreign markets in Latin America and China. Germany has lost her Alsatian cotton centre, the only region she could find damp enough for the production of fine yarns. Her leading manufacturing district is Saxony (Chemnitz, Plauen, and Zwickau), followed by Westphalia (München-Gladbach, Barmen, and Elberfeld), and minor towns in Silesia (Reichenbach) and South Germany (Augsburg). Before the War her consumption of raw cotton was less than half of that of Britain. The French cotton trade is not an economic unity. French genius is for variety rather than for mass production. The number of cotton spindles is approximately 8,000,000, and of cotton looms, 150,000. France has her cotton centres in the north-east coal-field (Epinal, Lille, Roubaix, and Tourcoing), the Vosges, and Alsace (Mulhouse and Colmar), and at Rouen. Japan has become of recent years a very strong competitor of Lancashire in the markets of the Far East.

WOOLLEN MANUFACTURES AND MANUFACTURING REGIONS. Wool is the most suitable fibre for clothing purposes in temperate lands, on account of its poor heat-conducting power, its failure to absorb moisture readily, its lightness and elasticity, and the ease with which it allows perspiration to pass through it. Compared with cotton, however, it is less uniform in character, is dearer, and more difficult to manufacture. Wool bales contain good, poor, and medium wool, all mixed together. The first operation, therefore, is the sorting of the wool into the different qualities. Next, the wool has to be freed from the yolk or suint which invests it. This is done by putting it into a long tank containing pure soft water and soap or ammonia. The water is kept at a uniform temperature, and the wool is gently moved along from one end of the tank to the other, and at last passed between rollers, which squeeze out the dirty water. It is then dried. The solid impurities, such as dirt and burrs which still remain, are usually knocked out by turning the wool upon a toothed roller against which revolving blades are made to strike.

All wool, except long wool for worsted, is carded. Carding consists in forcing the wool, which is sprinkled with oil to keep it supple, between toothed rollers working at different rates in order to spread the wool into an even layer of very loose texture. The final action of the carding machine is to divide the loose downy wool into narrow strips or slivers, which are made to pass through the condenser, where they are pressed between rollers. These rollers not only revolve, but also sway sideways, so that the slivers are compressed into loose soft threads, which only require twisting to make them into good strong yarns. The spinning and weaving operations are similar in many respects to those of cotton. When the cloth has been woven, it is scoured to get rid of the grease and dirt, and is then saturated with soapy water and rolled. The heated soapy fibres expand, and the innumerable tiny notches in them dovetail into one another so that a compact surface is formed, and all traces of the original weft and warp entirely disappear. After fulling, the cloth is raised by "teaseling"; sheared to get a smooth surface; finished by removing blemishes and carefully brushing; steamed; and pressed.

Felt is made by compressing the wool between rollers of different heating powers, after it has been combed or carded out into thin layers. Woollen cloth is made by carding, then spinning into a loose yarn, then weaving and, lastly, compressing like felt. Among the principal varieties of woollen cloths are broadcloths (the finest quality of cloth), cashmeres (fine thin twilled fabric), tweeds (looser and less highly milled than broadcloth), doeskins (twilled cloth), blankets, and flannels. Worsted cloths and worsted are made from the longest fibres, which are carded so as to lie, as far as possible, side by side in parallel lines; and then are spun and woven. Merinos, serges, hosiery, and carpets are branches of the worsted trade. Shoddy is a coarse but cheap kind of woollen cloth, made by tearing up cast-off woollen clothing and woollen rags into fibres, which are re-spun into a yarn, and then woven into cloth.

The British woollen industry is older than the cotton, but is less important and not so highly developed. The main output is from the eastern flank of the Pennines, where the dales run down to the West Riding coal-field. Leeds and Huddersfield specialize in woollen cloths; Bradford (the commercial centre) and its neighbouring towns in worsted; Halifax in carpets; Batley and Dewsbury in flannels and shoddy; and Saltaire in alpaca. In Scotland, Hawick, Galashiels and other towns make the well-known tweed cloth, and Alloa and Paisley produce knitting yarns and shawls. Bradford-on-Avon, Stroud, and Frome manufacture the famous West of England broadcloth, and Leicester has a large knit-goods industry. Flannels are made in several minor centres, and the domestic industry is represented by the homespuns of the Hebrides and Donegal. In France, the chief region is the Flanders coal-field, with Tourcoing and Roubaix as the chief towns. Sedan, Rheims, Elbeuf, and Vienne are other centres. France specializes in fine and dainty cloths, such as cashmeres, merinos, and delaines. The German woollen industry is scattered through Saxony (Chemnitz), Westphalia (Barmen and Elberfeld), Thuringia, Silesia and South Germany, and at Aachen. It is on about half the scale of the cotton industry. The woollen industry of the United States is making great progress. Much raw wool is imported, and thus Philadelphia has become the leading centre. The mills are very widely scattered over the industrial north-east, and the New England States have a large output of tweeds, worsteds, and dress materials of excellent quality.

Silk Manufactures and Manufacturing Regions. In the manufacture of silk the cocoons are first heated to kill the insect inside, then put into warm water to melt the gum which surrounds the silk fibres and causes them to stick together. The next process is reeling, which must be done by hand; the threads are unwound from the cocoon and wound on a reel. As the silk fibre is a continuous thread it does not require to go through the processes necessary in spinning other fibres. The threads average about 500 yds., and form the yarn for weaving silk cloth or for spinning into other yarns. The manufacture of true silk yarn is known as "throwing," and consists simply in giving the fibre a slight twist, which enables it to combine better with other fibres. For stronger fabrics several fibres of raw silk are united, being twisted into a fine cord. There is a good deal of each cocoon which cannot be reeled; this material is cleaned and then spun into yarn, which lacks the beauty and gloss of the thrown or reeled silk. Most spun silk is used with other materials, as in cheap ribbons, velvets where softness is required, plush, and sewing silk. Some, however, is woven into a cheap cloth, known in the trade as Tussore. The reeled silk is manufactured into the best ribbons and satin.

Japan has the leading position in the raw silk trade. Steam filatures and power looms have long replaced the old hand workmanship, and all the great towns carry on the industry, Yokohama being the principal market and the centre of the export trade. China ranks second to Japan as a raw silk producer, and is probably the oldest silk-manufacturing country. The chief centres are in the lower Yangtse region, at Shanghai, Hangchow, and Soochow; and at Hankow, Canton, and Chefoo. Italy produces more raw silk than France, but is not so important in the manufacture. Piedmont, Lombardy, and Venetia are the chief producers. Lyons, the historic commercial centre of the French silk industry, has the principal conditioning bureau, but the actual spinning and weaving operations are scattered through the lower Rhone valley. No other European country can compete with France in silk designs, patterns, and dyed goods in the piece. The German silk industry is not very important, and is centred at Krefeld, in the Rhine Province, and at Berlin. Much progress has been made in the silk industry of the United States. Raw silk from Japan is manufactured in New Jersey (Paterson), Connecticut, Pennsylvania, and New York State. Not only is the demand within the country for silk goods met, but there is an important export trade to Canada and Latin America. The

British silk industry is a small one. The weaving of reeled silk has almost disappeared, but there is a considerable amount of spun silk and its products. Macclesfield, Congleton, Leek, Bradford, Halifax, and Manchester are among the chief centres. Artificial silk—cellulose transformed into fine threads, and made lustrous—is becoming of great importance in the leading industrial countries. More than 150,000 British workers are employed in its spinning and weaving, chiefly in Lancashire, Yorkshire, the Midlands, and North Wales.

Linen Manufactures and Manufacturing Regions. Flax makes great demands on labour before it is ready for the market. As much of the valuable fibre is in the lowest part of the stem it is pulled up by the roots by hand. After being deprived of its seeds by means of an iron comb, called a ripple, the flax is tied into bundles and immersed in water for ten days or a fortnight. The water needs to be of exceptional purity, and its presence has helped to fix the linen industry in Ulster and Belgium. Fermentation attacks the non-fibrous parts which tend to drop to the bottom of the stream or pool in which the bundles are placed. Following this retting process, the bundles are spread upon grass for a few days to dry, and are then passed between rollers so that the woody part may be thoroughly broken. The flax is next beaten or scutched. This consists in further rolling out the flax with fluted rollers and beating out the woody matter with revolving paddles, although some scutching is still done by hand. Finally, the scutched fibre is " heckled " by gripping the ends between iron plates and lowering it between two revolving bands of interlocking teeth; these straighten out the fibre, and tear away the short or tangled fibres, known as tow. After scutching, the flax is ready to be spun and woven into linen. Fine flax thread can be worked only when wet and warm, and this condition is secured by passing the fibre, before spinning, through a bath of water heated to about 120° F.

Flax fibres are very long, fine, and supple, and linen is one of the most beautiful and durable of all fabrics. Linen products range from heavy coarse materials, such as ticks and huckabacks, to damasks, cambric, and Valenciennes' lace.

The linen industry ranks third among British textiles, and is of world importance. It is chiefly located in Northern Ireland

(Belfast, Londonderry, Lisburn and Newry), and in the east and central lowlands of Scotland (Dundee, Dunfermline, and Forfar). A small area around Belfast may be considered the hub of the world's linen production. In Germany the manufacture is mainly at Gorlitz in the south-east, and at Bielefeld in Westphalia. Lille and Cambrai, in France, make linen, muslin, cambric and lawn ; and there is a large industry in the best lace, which forms a valuable export. Flanders has long been famous for fine linens, and Courtrai on the Lys, and Ghent are the chief Belgian centres. There are small linen industries in the United States, Canada, Japan, Czecho-Slovakia, and Poland.

IRON MANUFACTURES AND MANUFACTURING REGIONS. Iron is extracted from its ores by many different methods, which depend on the quality of the ore, the fuel available, and the use to which the iron will be put. Carbon, when heated, joins very readily with oxygen, and the primitive way (employed to a small extent to-day) of extracting iron was to heat iron ore and carbon together in a furnace. The carbon (charcoal) then joined with the oxygen of the iron ore ; and the molten iron, thus united with some of the carbon, flowed out from the bottom of the furnace. In some such fashion, wasteful of timber and ore, the early Greeks and Romans smelted iron ores. Charcoal was mainly used in Britain till the middle of the eighteenth century, although coal was used with practical success by Dud Dudley as early as 1619. Coal effects a great saving in fuel, but even in the improved furnaces of to-day it fails to give as pure an iron as charcoal, as it usually contains sulphur and other noxious ingredients. Where forests are abundant, as in Sweden and Russia, charcoal is still used, and to this fact is due the high quality of Swedish and some Russian iron.

One of the chief difficulties of the early smelters was to keep the fire in their furnaces alight, and from the earliest time some sort of bellows was used. At the present time the blast furnace has taken the place of the ancient bellows. A modern blast furnace is a great hollow iron tower with a varying-sized circular section, lined with firebrick, and standing 60 to 90 ft. high. Near the bottom of the tower are pipes called "tuyères," through which a blast of hot air is driven at a pressure varying from 8 to 20 lb. per square inch, and at a temperature between 900° and 1,400° F. At the top of the furnace there is a hopper, closed by a cup and cone valve, which admits the iron ore, or "mine," fuel (coke), and flux (limestone). The oxygen of the iron ore unites with the carbon, and the iron is set free, though some of the carbon unites with the iron. The lime mixes with some of the various other impurities, and forms with them "slag" or "cinder," which, being lighter than the molten iron, floats on the surface. Exit pipes at two levels at the bottom allow the lighter slag to be drawn off through the upper pipes, and the heavier iron to run through the lower into moulds made of sand. The rough castings in the moulds are called pigs, and the crude cast-iron is known as pig-iron. There is usually 5 per cent of impurity in cast-iron, consisting chiefly of carbon, phosphorus, sulphur, silicon, and manganese. Both sulphur and phosphorus cause brittleness, sulphur to the hot metal, and phosphorus to the cold cast-iron. Cast-iron articles are obtained by melting together various qualities of pig-iron, mixed with some scrap-iron, and then casting the molten mass into sand-moulds of the shape of the article required. They can stand great heat, but are still rather brittle.

Wrought-iron is usually made from cast-iron by removing the carbon and other impurities. Pig-iron is put into a reverberatory furnace (one in which the fuel is in a separate compartment from the iron), the walls of which are lined with ferric oxide. The flame from the coal passes through the compartment containing the iron, and is beaten down by the sloping roof on to the iron. The heat causes the oxygen of the oxide to be set free, and some of it unites with the impurities of the iron and forms other oxides. As the impurities burn off the iron becomes more and more pasty. The plastic mass is puddled or worked by long iron bars put through a hole in the furnace door, and when sufficiently pure the product is withdrawn, and, while still soft, is hammered with great steam hammers, and then rolled under steam rollers. The rolled bars are then reheated and the product is wrought-iron, containing less than 0·5 per cent of total impurity and less than 0·1 per cent of carbon. Wrought-iron is soft and tenacious, and at a red heat may be hammered into any shape required, and two pieces may be welded together.

Steel is iron combined with a small quantity of carbon, the proportion of carbon varying from 0·3 to 1·5 per cent. The early iron makers had no means of regulating the amount of carbon contained in their steel, and, in consequence, there was no fixed standard by which it could be judged. There are various modern methods of manufacturing steel, and it is obtained from ores of various degrees of purity, though the finest steel, called crucible steel, is made from the purest ores and the purest carbon. In 1856, Mr. (afterwards) Sir Henry Bessemer invented his method of making steel, the commercial application of which is responsible for most of the iron, other than cast-iron now in use, for all but special purposes. The principle is first to get rid of all the carbon, and some of the other impurities of pig-iron, and then to put back carbon in the proportion required. Impure molten pig-iron is poured into the Bessemer converter, a pear-shaped vessel capable of taking about 10 tons of pig-iron and of being rotated to any position. It is made of wrought-iron and is lined with a mixture of clay and gannister. At the bottom of the converter there is a plug riddled with holes. Through these a fierce blast of air is driven. This oxidizes the impurities, and the heat of the reaction is sufficient to keep the metal molten. The silica and manganese combine with the converter lining to form a slag which floats on the top. The air-blast is continued until all the carbon in the iron has united with the oxygen in the air. Next, the calculated amount of " spiegeleisen " (a mixture of iron, carbon, and manganese) is poured in. The steel is then poured into moulds, and left until the outside has become solid, and while still hot is pressed between shaped rollers, and, finally, is cut into the lengths required.

The Bessemer process proved a failure with pig-iron, which contained phosphorus and sulphur. This difficulty was overcome by the Thomas and Gilchrist basic process, first practically applied in 1879. The converter has a basic lining, magnesium calcium carbonate (dolomite), with which the phosphorus and sulphur combine, forming a slag which floats on the top. " Mild steel " is the resulting product. Many ores in Europe and America have thus become capable of utilization.

In the Siemens-Martin or open-hearth process pig-iron is mixed with scrap-iron or iron oxide, and the mixture is heated on an open hearth in a lined basin by means of a blast of producer gas. The old cementation process is still employed for certain steels.

Wrought-iron bars are sealed up in fire-clay troughs along with a quantity of charcoal, in which the bars are embedded, each being separated by a layer of charcoal from the others. They are then heated for about a week, during which period they combine with the carbon, become much harder, porous and rough, and are known as " blistered steel." This, after being condensed by hammering and rolling, and remelted in crucibles to get rid of all traces of slag or cinder, forms the finest cast-steel, the chief material of the cutler. Special steels are made by this process on the introduction of calculated quantities of other metals to make alloys. There are over 200 kinds of steel to-day, each one the best possible material for some manufacture. All steels are very tough and tenacious, and can be hardened by cooling suddenly, but they differ considerably as to the temperature at which they are malleable. The alloy steels are made of iron with the addition of chromium, nickel, manganese, tungsten, or molybdenum. Chromium steel is used for armour-piercing projectile heads and stainless cutlery; nickel steel for the armour of warships and for shafting; manganese steel for crushing machinery; and tungsten and molybdenum steels for high-speed tools.

The iron industry is most largely developed in the leading commercial and manufacturing countries, and gives a good indication of the importance of various countries in world trade. The United States easily leads all other countries in its great and varied iron manufactures, its Steel Corporation controlling more works than any other world combine. Pittsburg, Birmingham, Newcastle, Wheeling, and South Bethlehem on the Appalachian coal-field, work the Appalachian and Lake Superior ores; and Cleveland, Buffalo, and Gary are famous lake-side iron centres. Chicago and Milwaukee manufacture agricultural machinery; Worcester, textile machinery; Philadelphia, Cleveland, and Cincinnati, machine tools; Milwaukee, Pittsburg, Philadelphia, New York, and Schenectady, engines and electrical machinery; and Philadelphia, Chicago, Pittsburg, and St. Louis, locomotives. Shipbuilding yards are numerous at the Atlantic, Lake, and Pacific ports, America now being second to Britain in shipping tonnage. The automobile industry is the greatest in the world, and has Detroit as its leading centre. Inexhaustible supplies of water-power at Niagara, in New England, and along the coast ranges of the Pacific, have given great importance to electrical industries, and there is a great production of electrical appliances and machinery.

The British iron industry now ranks second in world production, and is noted for the excellence of its products, and its premier position in shipbuilding. The great centres are the north-east coast (Newcastle to Middlesbrough), south Yorkshire (Sheffield and district), the Midlands (Black country), South Wales, the Scottish Midland Valley, and the north-west coast (Barrow and Whitehaven). Specialization is a feature of the industry. Sheffield specializes in cutlery, edged and machine tools, and ferro-alloys; the Midlands in articles which require a good deal of skill in making, such as bicycles, chains, general and domestic hardware, jewellery, and brass goods; and South Wales in tin-plate and galvanized iron sheets. The world's best textile machinery is manufactured in several of the leading textile towns of Yorkshire and Lancashire; while agricultural machinery of high repute is made in many of the chief market centres of the agricultural East. The automobile industry, centred at Coventry, Birmingham, and London, is on a large scale, but meets with severe competition from the United States and France. In shipbuilding, the Clyde and north-east ports and Belfast have the greatest shipyards in the world, and the greatest output. Locomotives and rolling-stock are built for home and export purposes at the great railway workshops of the large companies (Crewe, Swindon, Derby, and Darlington), and by the large engineering companies, and electrical goods are largely exported.

In Germany, the iron industry is well developed, and is steadily progressing, but the loss of coal and iron supplies from the Luxemburg-Lorraine-Saar areas seriously affects the output. Dusseldorf, Essen, Ruhrort, Duisburg, Dortmund, Gelsenkirchen, Remscheid, Bruchhausen and Solingen are the chief centres in the Ruhr region. Each has some special branch of engineering, Essen and Dusseldorf being the best known heavy engineering centres. Solingen and Tuttlingen are noted for cutlery; Zwickau and Chemnitz for textile machinery; Crefeld and Frankfort for ferro-alloys; and Magdeburg and Berlin for electrical goods. The Great German Steel Combine controls practically the entire steel business. German shipbuilding declined greatly after the War, but has recently assumed importance. The chief yards are at Stettin, Lübeck, Kiel, Hamburg, Bremen, Vegesack, Bremerhaven, and Rostock.

France now rivals Germany and ranks second to the United States as a potential iron-producing country, and may become the second in actual production. She depends on Ruhr coal for her supplies of coke, and her chief iron works are in Lorraine, on the north-east coal-field, and at Le Creusot, St. Etienne, and Caen. In the automobile industry, centred at Paris, Lyons, and St. Etienne, a foremost place has been gained. Belgium has important iron manufactures at Mons, Charleroi, Namur, and Liège. Poland, Czecho-Slovakia, Russia, Italy, Japan, and Canada, are other producers, promising greater importance in the future.

Chemical Manufactures and Manufacturing Regions. The chemical industries are " key " industries, for upon them depend, directly or indirectly, the manufacturing processes of the present day. Chemical processes are so many and often so complex that the reader is referred to works on chemistry. Four branches may be distinguished—the heavy chemicals (sulphuric acid, alkalies, etc.), the coal-tar derivatives (dye-stuffs, drugs, etc.), the electro-chemical (the manufacture of artificial manures by the fixation of atmospheric nitrogen), and the derived (soap, paper, leather, and glass).

Germany is pre-eminent in the chemical and dye-stuffs industry. Her advantages are the possession of large supplies of potash and other salts, the by-products of numerous coking ovens, much capital, technical skill and research. The Badische Anilin-und Soda Fabrik almost controlled the world's dye-stuffs market previous to 1914. In the by-products districts the chief works are at Ludwigshafen, Essen, Leverkusen, Elberfeld, Höchst-on-the-Main, Frankfort-on-the-Main, and Oppau ; while in the Elbe basin, where the natural salts are found, Merseburg, Schönebeck, and Stassfurt are the leading centres. At Munich and Burghausen, Alpine water-power is used in the electro-chemical works. Germany not only leads in heavy chemicals, fertilizers, and dye-stuffs, but also in the purest pharmaceutical products, laboratory materials, and glassware.

In the United States the chemical industry has shown great advance in recent years, especially in the manufacture of dye-stuffs, which is centred at Wilmington, Buffalo, Brooklyn, and New York. Many of the great industrial centres are engaged in the manufacture of chemicals, and the exports are in excess of the imports. The States have natural supplies of potash, many coking ovens, and much skilled labour. Britain has the advantage of abundant salt and limestone, and manufactures heavy chemicals with the help of imported sulphur or pyrites at Runcorn, Northwich, Widnes, Flint, Glasgow, Middlesbrough, Newcastle, and the Midlands. In dyestuffs and pharmaceutical products effective competition with Germany is difficult, but Huddersfield, Ellesmere Port, Manchester, and Middlesbrough, have recently made substantial progress. There is a highly-developed electro-chemical industry in Scandinavia at Notodden, Rjukanfoss, and Odde, and also in Switzerland and northern Italy. France, Poland, Czecho-Slovakia, and Belgium are other important producers of chemicals.

The raw materials for glass are flint, sand, alkalies, lime, and smaller amounts of other chemicals. Glass-making was introduced from Egypt to Rome and other Mediterranean cities in the first century, and Venice eventually became the most famous centre of the industry. The leading glass-producing countries, to-day, are Germany, Czecho-Slovakia, Austria, Poland, Belgium, Italy, the United States, Great Britain, France, and Japan.

Soap is a chemical compound resulting from the action of soda or potash on various fatty or oily substances. The leading countries are the United States, Britain, Germany, and France, which can easily import the necessary oils and fats. For the manufacture of paper the raw materials are wood-pulp, the Mediterranean grasses (esparto grass, alfa grass, and delta grass), cotton waste, linen rags, wastepaper, and some of the alkalies, together with barytes, gypsum, resin, and starch. The United States, the leading commercial countries of Europe, Scandinavia, Canada, and Japan are the chief producers.

Hides and skins are converted into leather, nowadays, by allowing vegetable or mineral tanning materials to act upon them for a sufficient length of time. The chief vegetable-tanning materials are oak bark, valonia, myrobalans, hemlock bark, sumach, mimosa bark, gambier, cutch, and quebracho ; while the mineral tanning materials are alum, chromium compounds, and hyposulphite of soda. The leading countries in the manufacture of articles from leather are the United States, Germany, France, and Britain.

EARTHENWARE AND PORCELAIN MANUFACTURES AND MANUFACTURING REGIONS. Pottery-making was one of the arts practised by early man, his first attempts probably being sun-dried bricks. The old system was to mould the clay and then dry it in the sun; later, artificial drying was used. To-day, in the chief manufacturing countries, where bricks and pottery goods are both made in millions, most of the clay is dried, ground, re-mixed, compressed into moulds, and baked. For the manufacture of ordinary pottery many kinds of clay will suffice provided that they are free from iron, which causes the clay to fuse during the process of baking. Other materials used are burnt and powdered flint, phosphate of lime, and felspar. Bricks and pottery are not waterproof until they are glazed. The glaze used is composed of various ingredients, and the exact means of melting it on to the pottery are, as a rule, trade secrets. Pottery can be divided into three groups—earthenware, fired at a low temperature; stoneware, which is heated to a higher temperature, and is usually inferior in character; and semi-transparent porcelain, almost a glass, which is heated to a very high temperature. The best pottery is made from kaolin found in Devon and Cornwall, Saxony (Schneeberg), the United States (Nebraska, South Carolina, Delaware, and Pennsylvania), and France (Limoges).

China and Japan are noted for the excellence of their porcelain. France, Germany, the United States, and Britain are now able to make glazes which are chemically the same as the ancient glazes of China and Japan. Localities, famed for decorative pottery and fine glazes, are the Potteries, Worcester and Derby in Britain; Meissen (Dresden china) in Germany; Faenza in Italy; Sèvres and Limoges in France; Copenhagen in Denmark; Delft in Holland; Rostrand in Norway; and Rookwood in the United States. The leading pottery-manufacturing countries are Great Britain, Germany, the United States, and France.

CHAPTER IX

COMMERCE—THE PHYSICAL AND HUMAN CONDITIONS AFFECTING COMMERCE

> "The whole world as to trade is but as one nation or people, and therein nations are as persons."—*Dudley North.*

> "The band of commerce was designed
> To associate all the branches of mankind."—*Cowper.*

COMMERCE is the exchange of products most easily produced in certain regions for other products most easily produced in other regions. It is the last link in the chain of productive activity; and results from two basic differences—the differing tastes and aptitudes of man, and the varying physical environments in which he lives. The beginning of commerce was barter between two individuals, each of whom had a surplus of a particular article, and found advantage in the exchange of that surplus. The most complex phases of modern commerce are but the outgrowths of this simple exchange of goods, complicated by the numerous and growing wants of man, the variety in natural resources, the world-wide distribution of industry, and the myriad complexities of invention and manufacture.

In the earliest periods the articles in which commerce was engaged on a large scale involved long and costly journeys, and were necessarily goods of great value in proportion to their bulk. Such commodities were the luxuries of the rich and the religious. Records of early Egyptian, Babylonian and Phoenician trade make mention of gold, precious stones, ivory, incense, and perfumes. It was not till Rome had reached the height of her prosperity that a great trade arose in the necessaries of life; and even then commerce, which necessitated long carriage by land, was in luxuries. At the close of the fifteenth century the principal articles of commerce were raw silk, silk stuffs, and other costly manufactures, spices, and drugs. With improvements in roads and the art of navigation, trade extended to comforts. To-day, the mass of the world's trade consists of the necessaries of daily existence, and has become possible only through the development of shipping and railways in the latter part of the nineteenth century.

Exchange takes place between countries because countries are specialized, and are able to obtain the goods they need more easily by offering their own special products in exchange for them, than by producing them in their own lands. As a rule, exchange between different countries is more difficult than between different districts in the same country. The difference in language, in currency, in law and trading custom, the greater distance and the greater risk involved usually in foreign trade, and the import duties deliberately imposed by Governments, are all obstacles to the free movements of goods. In spite of all these obstacles, however, the buying in the cheapest and selling in the dearest market by merchants links countries together ever more closely, and international specialization, with its correlative international exchange, steadily increases. Climate, the character of the soil and mineral deposits, the density of population, and the degree of industrial development, fit different countries for different branches of production; thus, when different countries give most of their productive powers to the work for which they are most fitted, mankind is greatly benefited. Each country utilizes, to a greater degree than would otherwise be possible, its natural and social advantages, and obtains in exchange for its own goods the products of other countries more cheaply than it could produce them itself in the same quantity. Countries, however, sometimes import from other countries commodities which they could produce more cheaply than the exporting countries. Britain, with better climatic and soil conditions, imports dairy produce from Denmark, and wheat from India, where farming methods are poor. The fact that a commodity can be produced at a lower cost by one country than by another is no guarantee that it will pay the first country to produce and not import it from the second; there may be other commodities in the production of which the first country has an even greater advantage, in which case it will specialize in them. It is the comparative cost of producing different commodities in different countries which determines the specialization of countries. Countries tend to concentrate on those commodities in the production of which they have the greatest relative advantages. Each country, by specializing in those commodities for the production of which it has the greatest relative advantages, obtains a bigger return for its expenditure of labour and capital than would be the case if it did not specialize, but devoted part of its efforts to producing the commodities for which it is relatively less well-fitted. The theory of international trade, which has just been propounded, is an ideal theory of the condition of things that would exist, if the world were ruled by an all-wise body, viewing the earth only as a whole. But the world is divided up into a number of separate nations of varying environments and heredity, whose trade policies are not yet governed by cosmic ideals. World-wide free trade would, by the force of competition, compel each nation to devote itself to the production of those commodities in which it has the greatest advantage; but each nation, to-day, considers the actual measures which seem likely to prove of the greatest advantage to its own peculiar national interests, and not infrequently produces goods for which it has relatively few natural advantages. Yet, the bulk of the world's industry is carried on in the countries best suited to it, and the close linking of nations by ever-improving means of transport tends towards the future consummation of the ideal theory. The world is now a single economic system, and the problem to be solved is not how to live separately, but how to live together, harmoniously.

The cost of the imports of a country is its exports; but the total recorded imports and exports of any country rarely balance. Records are kept only of material commodities, while a country usually supplies and receives from other countries services ("invisible" exports and imports) as well as commodities. Great Britain supplies other countries with a large part of the services of her mercantile marine, her banking system, and her insurance companies. Since she receives much less than she gives in the case of shipping, banking, and insurance, she receives more goods (recorded imports) than she exports to make up the difference. Further, foreign investments in Britain are much exceeded by British capital invested abroad, and thus the extra interest must be balanced by extra imports. Over a sufficiently long period of time imports balance exports. The purchases that a country can make are limited by the value of the goods and services that it can sell to other countries.

THE BASIS OF COMMERCE.—Commerce is stimulated or retarded by geographic and economic influences—the physical environment and influences devised by man. Favourable winds, currents, mountain passes, and location of natural resources have aided commerce ; while natural obstacles to trade are high mountain ranges, deserts, contrary winds, and seas and rivers difficult to navigate. Nature is usually on the side of the wisest and bravest traders, and it often happens that the geographic hindrances of one age are the aids of a succeeding age. Man aids commerce by his means of transport, his subsidies, his commercial agencies, and his treaties ; but his tariffs and non-intercourse arrangements create a wall of division. Almost universally, however, nations pass from an economic policy of exclusiveness to one of commercial interdependence, a relation of mutual help. " No form of man's energy has done more than the commercial aspect to link together distant and diverse races, to bring about the discovery of the earth, to promote truly useful knowledge, to broaden the mind, and to break down obstacles, both mental and physical, which once hemmed in mankind and separated its lands and peoples from one another. Contained within the history of trading lie all the romance and adventure of the sea and the frontier, the horrors of war, the privations and sufferings of exploration, the rise or fall of nations ; in brief, the story of civilization and barbarism." (*Selfridge.*)

Different Regional Conditions. International trade depends on the differences in conditions in different regions. First, are the differences between the natural resources of different regions. Some countries are rich in mineral wealth ; some are specially suited for arable agriculture ; and some are best devoted to pastoral pursuits ; while each of the various climatic regions has its own characteristic vegetation. Second, there are differences in the industrial development of regions. Old developed countries in the west are largely manufacturing ; whereas most eastern and " new " countries depend mainly on agriculture, mining, and lumbering. Lastly, there are racial differences. British products are characterized by strength and stability, German by their dependence on science, French by taste and skill, and Eastern products by patient artistry. Racial differences, expressed in the products of nations, tend to be obliterated as nations come into freer contact, and develop unlimited rivalry with others. Machinery is eliminating differences of artistry, and the spread of civilization is removing differences between peoples. "New" countries are gradually filling up and becoming industrial with a consequent tendency to decrease their export of raw materials and their import of manufactured goods. The two latter causes of international trade, therefore, tend to decline in power, and the first is destined to be the permanent factor controlling the commerce of the future, though it is probable that manufacturing countries will always continue to exchange their manufactures, but in a lesser degree. The great manufacturing nations of the world are in the temperate regions which have available sources of power, and they must obtain food products and raw materials from tropical lands, sending in return machinery, cloth, and various manufactured goods. This north and south or south and north trade will persist, for it is improbable that tropical lands will ever become important centres of manufacture. East and west trade between temperate lands will change as "new" countries become industrial, and it is possible that old lands will be compelled to produce much of their own food by more intensive agriculture, and gain tropical foods in greater quantities by scientific organization of tropical agriculture. It is important to note that in the thrifty progressive nations domestic trade is of far greater importance than international commerce. Exact commercial statistics of the home trade are practically impossible to obtain, but Dr. Bowley has estimated that, in 1913, only 30 per cent of the home-produced income of Britain was derived, directly or indirectly, from foreign trade. The unparalleled diversity, abundant resources, and versatile population of the United States make her trade predominantly domestic, and her foreign trade much less *per capita* than that of Britain.

THE INTRODUCTION OF MONEY.—Exchange by barter was at first inter-tribal or international rather than local. Every member of each tribe was engaged in the same occupations, and, therefore, produced the same commodities as his neighbour. When, however, chance encounters brought nomadic tribes into contact with other tribes living under different environments, opportunities for exchange arose; and, gradually, journeys came to be undertaken purposely to attain this end. The development of agriculture gave fixed homes and horizons, unfolded the possibilities of the division of labour, and greatly increased the population. Exchange of the different products became essential, and as the village developed into the town, and the town into the nation, exchange became wider and more universal, keeping pace with the growth of specialization and the division of labour. In intercourse with uncivilized peoples barter is still necessary ; but this direct exchange of goods for other goods implies a double coincidence of wants, much higgling over values, and a great waste of time. The impossibility of doing business speedily and satisfactorily by means of barter constrained peoples to introduce a universal third commodity, called money, as the means of exchange. Every man is then able to sell his goods for money with which he buys other goods of whatever kind from whatever person in whatever quantities and at whatever time he wishes. Money thus breaks up the transaction into two separate acts of barter, one of goods for money, called sale, and the other, which may be far removed in time and place from the first, of the same money for other goods, called purchase. The best money-material is that which is of universal desire ; is not subject to rapid changes of value ; is capable of being divided up without losing in value ; is convenient to carry about ; is recognizable at sight by the most ignorant people who use it ; is of intrinsic value ; and is comparatively imperishable. Gold and silver, universally desirable, of great intrinsic beauty and comparative scarcity, best fulfil the conditions. At first the precious metals were used in the form of ingots or small pieces of the metal, which had to be assayed and weighed in order to ascertain their value. Then, to make exchange more easy, the practice grew among merchants of making their ingots of a fixed standard of fineness, and putting upon them their own private marks. Where confidence was reposed in the merchant, his mark was taken as a guarantee of fineness, and only weighing was necessary. The period at which the precious metals were first made into coins is unknown, but they were used in the early civilizations of Assyria, Lydia, and China. Gradually, the various governments of nations adopted coinage as their exclusive business, marking their coins with their own distinctive marks, fixing the weight and standard of fineness of the precious metal in their coins, and making them legal tender. Like all other commodities, money comes under the influence of the laws of supply and demand. The supply of money is the quantity of money offered in the purchase of goods, and the demand for money is the quantity of goods and services offered for sale and hire. The value of money is its purchasing power, which depends upon the general level of prices. This level varies with the relation or proportion between the total amount of money in circulation, and the total amount of goods or commodities in existence which must be exchanged for that money. Changes in the supply of money usually take place slowly and imperceptibly; but, occasionally, as in the discovery of the silver mines of Potosi in the sixteenth century, and of the gold mines of California, Australia, and South Africa in last century, and the very rapid increase of paper money in all the combatant countries during the Great War, the increase has been great and rapid, and has expressed itself in higher prices.

Standard and Token Money. Coined money is of two sorts—standard money and token money. The former is that in which the fine metal used fixes the standard of all the coins used in the country. Whatever metal is chosen must be received for coinage in unlimited quantities by the State, and coins made with that metal must be made unlimited legal tender, that is, capable of discharging any debt, however large. The central point of the English system of currency is the sovereign, made of standard gold, composed of eleven parts of fine gold and one part of alloy, chiefly copper, the value of the gold being represented, normally, exactly by the value of the coin. Coins of which the metal value is, normally, less than the face value are called token coins. The value of the fine metal in them is fixed by law in relation to the value of the standard metal. The non-standard metal is not received in unlimited quantity for coinage at the mint, and the coins are never legal tender except up to a low limit—up to 40s. in England for silver coins, and up to 1s. for copper coins. The profit made on token money goes to the Government. Coined money is used only to a limited extent in the discharge of large pecuniary obligations, even in domestic trade, and is practically absent in foreign trade.

Substitutes for Coin. A coin is simply an order on every producer to hand to the bearer a certain quantity of goods, and that order can be conveyed quite as well by means of a written paper, provided common consent is behind it. The equivalent of coin in paper is, therefore, the more usual mode of payment in the case of all but small transactions, and the proportion of debts discharged in this way usually increases with the commercial development of countries. Whatever the form of paper currency may be, its efficiency as a perfect substitute for coins depends on the ability of the holder of the paper to obtain always the equivalent in coin. In payments made within the bounds of any particular country, bank notes and cheques are the usual substitutes for coin. Bank notes are promises of a bank to pay; cheques, orders to a bank to pay, made by persons who have money at their credit in the banks on which the orders are made.

Bills of Exchange. It sometimes happens in large transactions in the home trade, and almost always in the foreign trade, that payment is made in the form of a bill of exchange. This is " an unconditional order in writing addressed by one person to another, signed by the person giving it, requiring the person to whom it is addressed to pay on demand, or at a fixed and determinable future time, a sum certain in money, to or to the order of a specified person or to bearer." (Bills of Exchange Act, 1882.) Such a demand is presented to the merchant on whom it is drawn for his acceptance, which he signifies by his signature, and thereby makes it a valid claim against him. It has been well said that: "Commerce, in all its phases except the very rudest, has avoided the sending of money, coin, or the precious metals in any other form, on long journeys, when it could be avoided by means of arrangements between neighbours. If A in London owed money to B in Norwich, and C in Norwich owed the same sum to D in London, the two debts could be extinguished without the expense and cost of sending money by the simple arrangement that A should pay D, and C should pay B. Hence arose Bills of Exchange, and the machinery of the Exchanges." The primary function of a bill of exchange as a means of transferring debts from one person to another, and thus economizing the transference of command over ready purchasing power in space and time (as illustrated by the transaction of the London and Norwich merchants in the home trade), effects similar economies in settlements between nations. It is obviously cheaper under ordinary circumstances for a merchant who has a claim against him in another country to send over an equivalent claim which somebody else may have on some one in that country, rather than coin or bullion on which freight, interest, and insurance charges have to be paid. He buys that claim in the form of a bill of exchange, and pays for it at a rate which varies, according to the credit of the person or persons accepting the responsibility for the bill, the time for which the bill has to run, and the state of trade between the different countries. The supply of bills depends on the number of merchants who have sent out goods from the country, and have received bills in payment ; the demand for bills depends on the number of merchants who have brought goods into the country and must buy bills to meet the cost of these imports. The supply of, and demand for, bills are, therefore, dependent on the balance of imports and exports for each country. If a country is importing more than it exports, the rate of exchange moves against that country ; if it is exporting more than it imports, the rate of exchange moves in favour of that country. Thus, if the claims held by France against Belgium are greater in the aggregate than those held by Belgium against France, the holders of the former would not easily find purchasers : and a French bill on Belgium for, say, 10,000 francs would sell for less than 10,000 francs, while Belgian bills on France, being scarce, would sell for more than their face value. The exchange is said to be " Favourable " to France, and " Unfavourable " to Belgium ; actually it is favourable to those who bring goods into France from Belgium, and unfavourable to all who send goods in the opposite direction. If the exchanges become so unfavourable to Belgium that a bill for 10,000 francs on France in Belgium sells in Belgium at a premium greater than the cost of sending 10,000 francs worth of gold to France, then exchanges have reached the " gold point " at which it pays to send gold from Belgium to France. If, on the other hand, the exchanges become increasingly favourable to Belgium, and therefore unfavourable to France, the other " gold point " is reached, and gold flows from France to Belgium. These results follow when the international currency, gold, can be freely moved. At the present time the exchanges are abnormal owing to the facts that the movement of gold by European traders is restricted, that the price of gold has risen considerably higher than the mint value, and that European debtor governments have poured gold into New York. The abnormality of currencies depending now upon the prices prevailing in their respective countries, and exchanges oscillating round a " par of purchasing power " instead of a " gold par," will eventually pass giving place to more stable rates of exchange, and fluctuations confined within fairly narrow limits above or below the old " gold points."

One country is able to pay another in a roundabout fashion by exporting bills of a third country which are in demand in the creditor country. England has large payments to make to America, and has large payments to draw from China ; while America usually has large payments to make to China. Economy is effected by England discharging part of her obligations to America by bills on China. The whole of a well-developed country's imports (visible and invisible) from the world at large are now set against the whole of her exports (visible and invisible) to the world at large ; and that part of the total adjustment which is consigned to imports and exports of the precious metals is, normally, relatively small. It is interesting to note that the terms " favourable " and " unfavourable " balances of trade are a survival of the times when it was commonly thought advantageous to attract bullion to a country. Nowadays, it is recognized that the real wealth of a country lies in its natural resources, and the skill, energy, and industry of its inhabitants ; that each nation requires just such a volume of currency as will efficiently do the work of exchange and provide a safe surplus for contingencies ; and that the ideal state of the foreign exchanges would be reached if all the exchanges stood at par. Possibly, the League of Nations may, in the future, secure a universal monetary unit, paper or gold ; but the ideal state of the exchanges will never be attained, for the variations in those national activities which make one nation debtor to another will always occasion variations in the amounts to be received or paid by one nation to another at any particular moment.

CHAPTER X

THE TRANSPORT OF GOODS BY LAND, WATER, AND AIR

> " Of all inventions, the alphabet and the printing press alone excepted, those inventions which abridge distance have done most for civilization."—*Macaulay.*

> " Months have been cut down to weeks, and weeks to days in the transport of men and things, and unless all signs fail we are on the edge of further unbelievable cuts in time....Before long any man in any quarter of the Empire will be able to call for and be answered by the voice of his own birth-place at its work or play. That means that it will be possible for us now as never before to fuse our Empire together in thought and understanding as closely as in the interchange of men and things."—*Rudyard Kipling.*

LAND TRANSPORT.—Roads. Transport has been vital to trade in all historical ages, and many present world problems may be expressed in terms of transport. The oldest transport ways were the paths from one village to another, and later, when man began to use his domesticated animals as beasts of burden, these paths became tracks wide enough for pack animals. Long-distance transport of luxuries—ivory, gold, silver and precious stones—by caravans of from 8 to 30 or more laden animals followed in Western Asia and North Africa. Still later, wide and often good roads for the carriage of both necessaries and luxuries came in southern and north-western Europe. Early routes in Britain were the primitive footways and ridgeways of the Scarplands, which later developed, in some cases, into broad clearings through the woods and forests, affording a means of communication throughout Britain. True roads, indestructible and strong, however, originated only with the advent of the Romans. These were military roads, taking a straight course as long as the slopes crossed were not much more than 20°. They led, in most cases, from a port on one side to a port on the other. Thus, one road traversed the country from Dover through London to Chester. Throughout the Middle Ages the roads steadily decayed, and villages became largely self-sufficing. Footpaths and bridle-paths rudely connected the villages, often running round fields and woods, and developing into winding country lanes. Selfish craft gilds and conservatism hindered trade and transport, with the result that the only good roads before the seventeenth century were those near monasteries and those leading from the chief fair towns. The products of the loom, the coals of Newcastle, and the pottery of north Staffordshire, were carried along the bridle-paths on pack-horses.

By 1700, wheeled vehicles and coaches had become fairly common; but the real improvement in roads began in the late decades of the eighteenth and early decades of the nineteenth centuries with the work of Metcalfe, Telford, and McAdam, who began the system of paving roads with small granite stones well rolled down, thus solving one of the problems retarding the Industrial Revolution. Engineers consider a gradient of 1 in 30 the greatest allowable, and modern roads generally follow the easiest routes, running up valleys, climbing hills by easy gradients across the stream lines, and taking advantage of gaps and cols when crossing mountainous tracts. The means of locomotion are becoming more and more rapid; and, as steep gradients mean slowing of speed, increased consumption of fuel, and less economic working, the modern engineer diverges from the Roman plan over more suitable ways. Easier roads come to be made, and grades on old roads are improved by filling the hollows and cutting down hills. It often pays to spend money in extensive engineering, and in making roundabout roadways, than in combating steep hills on short roads. The petrol-driven motor, which has largely driven the horse from the roads and competes over short distances most successfully with the railway engine, runs best and most efficiently on tar-sprayed macadamized roads, which follow a line somewhere between the stage-coach road and the railway. Roads are now almost regaining the relative importance they held in the coaching-days of over a century ago; many new trunk roads are in the making; and, possibly, in the future, special motor-roads may be established.

There are many areas of the world to-day where long-distance transport of goods over rude and good roads is still carried on by human labour or by beasts of burden. Horses, asses, mules, and oxen are used in temperate and sub-tropical lands; camels in the deserts; dogs and reindeer in the polar regions; elephants in the tropical swamps; the yak and llama among the snowy passes of the Himalayas and Andes respectively; and human porters in

Africa (especially where the tse-tse fly is found), China, south-eastern Asia and Japan. It is probable that the transport problem of desert areas will, finally, be solved by specially constructed motors, airships, and railways.

Railways. Transport by rail is still the most important method of inland transport. Road transport by motor truck is yet in its infancy. In a country of short distances like Britain, it promises, however, to become a serious rival of the railway ; but in continental areas the latter has the advantages of speed, reliability, and cheapness. The difficulty of dragging coal from the mouth of the pit over bad roads to river or canal led to the evolution of the railroad, and the great cost of horse-feed brought about the invention of the locomotive. Originally, " railroads " were roads on which rails of wood or metal were laid down to facilitate the passage of ordinary vehicles. Wooden rails are said to have been in use as early as 1630, and appear to have been fairly common in 1676. Thin plates of iron were soon put on the wood, and about the middle of the eighteenth century cast-iron began to replace the wood. In 1801, the first actual working iron railroad from Croydon to Wandsworth was opened. Wrought-iron was substituted for cast-iron in 1824, and later came the steel rail. The motive-power at first was supplied by men or horses, and afterwards by stationary engines. It was long before railways attempted to compete seriously with inland water-traffic, drawn by horses, for the carriage of common products in bulk. Now, the modern railway associates all the branches of mankind, and, literally, exalts the valleys and lays low the hills. The modern railway presents the union of two ideas, the metal rails to reduce friction and to secure full control of rapidly-driven carriages, and the steam locomotive to supply mechanical power. Steam railways suited the British temperament, and they were fortunately aided by parallel developments of the banking system, the postal service, the telegraph, and the newspaper ; in all of which Britain was ahead of her rivals. Following on the respective work of Savery and Watt on stationary atmospheric and condensing steam engines, Trevithick, in 1804, built a locomotive, which would travel a short distance ; and in 1825 George Stephenson gained full success with his engine, " The Locomotion," which ran on the Stockton to Darlington line at a speed of 12 miles per hour. In 1830, he made further progress with the "Rocket," which attained a speed of 29 miles per hour on the Liverpool and Manchester line. Britain's industrial development gained many years' start on the rest of the world by the invention of steam railways and steamboats; and many countries owe their railway networks to British engineers and British methods.

Effects of Relief. The strength of the railway lies in its speed. Decrease its speed and its efficiency is reduced. A more or less definite rapid rate is essential for economic working. As a railway engine gets its pulling power by smooth wheels gripping on a smooth rail, it is obvious that the steepest gradients practicable must be much more gentle than those for road traffic. The reduction of speed on a long incline, the grinding of the driving wheels of the locomotive on the track, and the laboured pounding of the engine in its upward struggle, are eloquent testimony of costly wear and tear on rolling-stock and permanent way. Where the gradient is very steep the hauling-power of the engine may be beaten. The steepness of hills in connection with railway construction is, therefore, strictly limited. Engineers avoid steep gradients, the cost of which may be cheap at first, but afterwards prove to be permanently expensive in running trains over them. George Stephenson declared that a gradient of 1 in 133 should be the maximum; but he, as pioneer, had no conception of the powerful modern locomotives such as draw heavy trains from Tebay to Shap summit, where for 7 miles the gradient is 1 in 75. In practice, for main railways where speed is wanted, a slope of 1 in 200 is considered the steepest desirable; but through passes this often cannot be obtained. Still, on first-class railroads, the gradients are seldom steeper than 1 in 50, and 1 in 25 is exceptional even on primitive lines. Many small slopes are avoided by cuttings or embankments, and the general level of the railway is often decided by the height at which rivers or main roads must be crossed by bridges. When ascending a valley to a pass the railway keeps some distance from the river and road at the bottom, and climbs slowly along the side of the valley; for, by beginning its steep slope sooner than the road does, it will reach higher up the valley before a tunnel is necessary. The most suitable pass is not that which has a nearly uniform slope as for a road, but that which provides the longest slopes not steeper than 1 in 80 on the two sides; the top of the pass can then be pierced by a tunnel. Sometimes the valley-lines on the two sides of ridges or scarps do not correspond but alternate. The problem is then solved either by cutting or tunnelling, or utilizing a third basin as on the main Midland line of the London, Midland, and Scottish system between Leeds and Carlisle, which ascends the valley of the Aire and deviates into that of the Ribble in order to get into the Eden valley. Where the coast of a country consists of a broken scarp or line of cliffs, the main-line keeps away from it, and important centres on the sea are reached by branches, as on the Southern Railway east of Exeter, or the main-line of the London and North-Eastern between Darlington and Berwick-upon-Tweed. Where the scarp is fringed by a coastal plain, the main-line traverses the plain, and throws out branches to inland points, as on the Great Western Railway through Cardiff and Swansea, which sends branches into the parallel valleys of the coal-field of South Wales. Whenever plains are separated by ridges or scarps the connecting routes make for the gaps, and there are excellent instances of strenuous endeavour in this direction in the lines radiating from London to the manufacturing Midlands, which cross the chalk and oolite escarpments by gaps of varying degrees of accessibility and convenience. More formidable ridges or mountain groups give generally fewer passes; and, therefore, the concentration of routes becomes more severe as the topographical control becomes more complete. The great railway routes of northern Italy are illustrations. To cross the great highlands, such as the Alps, and the western plateaux of America, spiral tunnels, which burrow into the slope of the valley and reappear exactly above the entrance, are sometimes used. Deep cuttings and long tunnels are avoided wherever possible because of their costliness of construction. Curves are often adopted by engineers as a means of avoiding greater expenditure; but they have to arrange the bends so that no curves are made too sharp, by following a contour line closely. In steep valleys, the railways zigzag from side to side, and many sharp bends are encountered, and these lessen speed. The engineers, therefore, keep their bends as wide as possible (they prefer curves of a greater radius than one mile), and so in avoiding extreme slopes, as on the St. Gotthard route, they are forced to make tunnels in the flanks of the mountains.

In mountainous countries rack railways, and more particularly the modification known as the Abt system, in which the locomotive can use the rack or toothed rail on steep gradients (even 1 in 2), and, on level tracks, can proceed in the ordinary manner, have helped railway growth. Relief of a country is obviously a powerful factor in directing the course of railways; but it should be noted that the material and structure of the surface and underlying rocks have also their effects on the rigidity of the way. Mountain barriers still exclude or deflect railways; but the modern engineer laughs at difficulties; makes his railways ascend the Andes to a height of 15,600 ft.; pierces the Alps in tunnels 7 to 12 miles long; suspends aerial bridges above deep and gloomy ravines; rends the rocks and fills the hollows; and links with an iron and yet loving grasp all nations of the earth.

Effects of Trade. Not only topography but trade is a chief factor in controlling the course of railways. Where there is trade, or the probability of trade arising with the birth of a good transport system, railways come into existence. Here lies the cause of the difference in the history of railway development in old and new countries. In the former, trade was developed and largely localized before the coming of the railways, and lines were built to connect the various centres and the neighbouring sources of raw materials. Early British railways were local and of varying gauges. Trunk-lines developed later when their advantages became appreciated and the objections of the public were overcome. Then to facilitate through traffic, uniformity of gauge was introduced. The cost of construction of British railways has always been heavy on account of the high cost of land in populous districts; the insistence of the State on a very high standard of work to ensure public safety, and on uniformity for strategic reasons; the vested interests to be bought out and compensated; the costly inquiry by the State on every scheme; and the high prices demanded by owners of land, who saw the urgent need of the railway companies and so took advantage. In new countries like America, land is often cheap; control is less strict; and large gifts of land are made by the State to the companies in order to create new lines to foster industry, settlement, and the authority of the State.

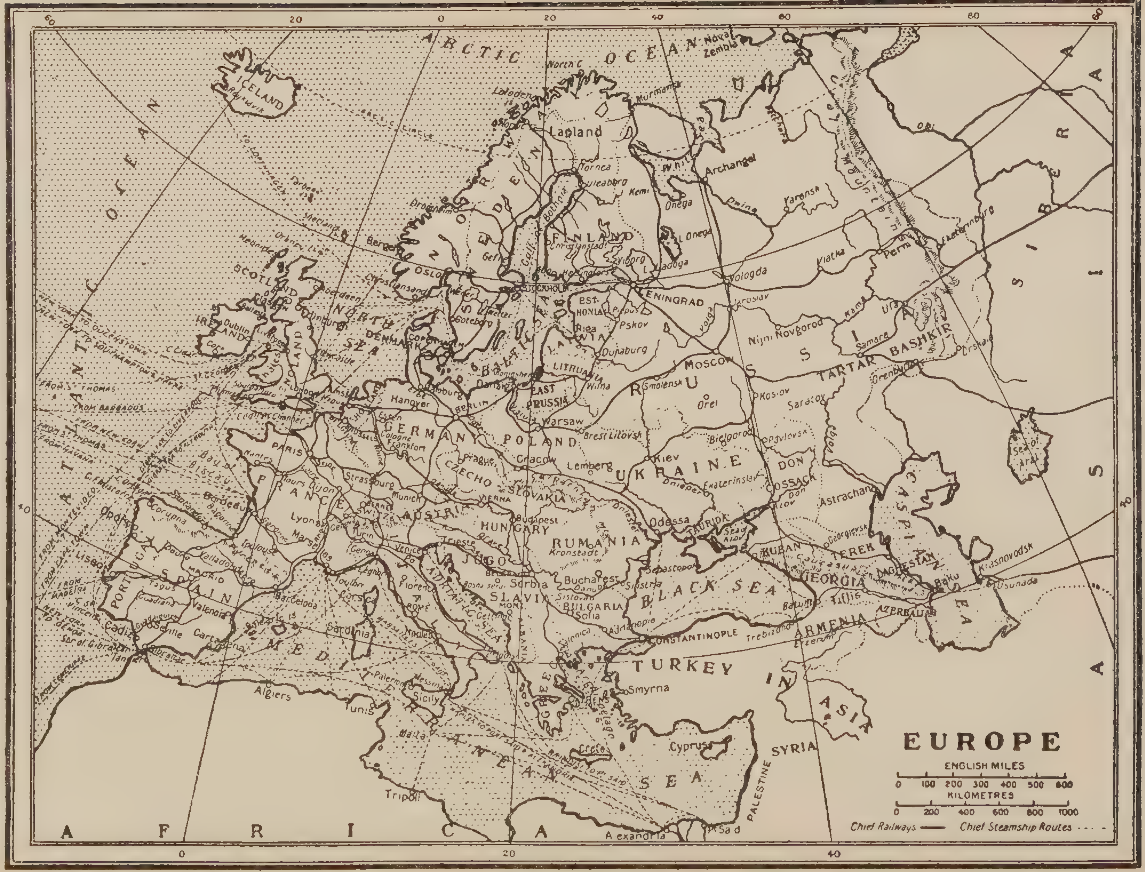
Gauge. For freight traffic (usually the most profitable part of the work) smooth running is not so essential as for passenger traffic, and the railway may be less strongly built. Traffic of small volume can be coped with by vehicles of small capacity on narrow-gauge lines; but the most satisfactory gauge where large volume of traffic, speed, and comfort must be considered, has been proved by practical experience to be 4 ft. 8½ in., a gauge adapted from that of the horse-drawn vehicles on the first railways. In new thinly-populated countries, traffic is small and high-speed of travel is not obtainable on the revenue; and thus less costly narrow gauges prove efficient. Examples of these are provided by the West Australian, Cape, and New Zealand lines, which have the metre or 3 ft. 6 in. gauge. Convenience of through traffic necessitates uniform gauge, and in continents, such as Australia, where gauges range from 2 ft. 6 in. to 5 ft. 3 in. (owing to former State jealousies and their lone development), freight charges become heavier and time is lost. For strategic reasons some countries have adopted a different gauge from that of their neighbours; thus, the Russian gauge is 5 ft., and that of Spain 5 ft. 5¾ in. Single lines, with short double lengths at intervals, so that trains can pass each other, are built in sparsely populated regions as in the Scottish Highlands; but "up" and "down" tracks are essential where trains are frequent in order to avoid dislocation and delay; and, on very busy lines, as those between London and the Midlands, four sets of metals are necessary to cope with the volume of traffic. Wide barren or desert tracts of several continents are "bridged" by railways to connect settled districts. The difficulties are many. Local trade is absent; provision for water must be made; desert sands block the line; and the construction and upkeep of the permanent way are very costly. These lines are rarely remunerative; but various governments, looking to the future development of their countries, have been willing to lay down the lines. Examples are the new Australian railway from Perth to Adelaide, and the more southerly of the trunk railways of the United States.

FREIGHT CHARGES. The income of a railway must bear the interest on the heavy first cost; meet the charges for cost of working, handling of goods, and insurance for damage and loss of goods; provide for maintenance, and a sinking fund for the liquidation of debt and for development; and yield a profit to the shareholders. Each freight charge bears its share under each of these heads, and the charges are based on the costs. Fragile material is costly to handle; is usually more bulky than other articles; requires shelter in transit; and makes greater demands on a railway company's insurance scheme. Rates are, therefore, higher for fragile goods, such as furniture, than those for coal and timber. Competitive rates must also be fixed. Commodities, such as coal and pig-iron, go, as a rule, by the cheapest means of transport. In Britain, the coal traffic is a large one, and it pays the railways to carry it cheaply. British companies built their lines originally to be used by the rolling-stock of any traders who cared to pay for the privilege. So privately-owned railway wagons of various sizes and designs are still largely employed with a resulting loss in economy. It has been stated that standard wagons of 30 tons would save 100 per cent in running costs, and much congestion and labour. Standard wagons are generally in use in countries which developed their railways after the British, and so avoided the pioneer mistakes. Between Denmark and Sweden train-ferries solve one of the difficulties of transport, and ship-railways have been proposed to cheapen transport. Light railways of standard or smaller gauges, for simpler, slower traffic, and lighter loads, are very useful in mining and agricultural districts. In recent years, the electric trolley-car has taken from the railroads much of their profitable suburban passenger traffic; and has invaded their inter-urban traffic, and even their express and freight traffic. Electricity, however, may be applied more largely on the railways (it has been utilized successfully on local lines), and the present compulsory amalgamation of railway companies must lead to further economies in transport.

European Railways. The countries of continental Europe have obtained their superior network of railways largely as the result of State enterprise; and, though many of the lines were planned chiefly for strategic purposes, commercial reasons were also present. Many sea avenues lead into the heart of Europe, thus lessening the need for the easy east-west railway routes of the Great European plain. North-south lines meet the southern mountain barriers—the Alps some two degrees in width, the Pyrenees, and Caucasus. Yet, largely on account of the alternative west-east cheap water transport, these are the most important lines. The Rhine and the

Danube provide easy passages at each Alpine end, and there are numerous passes without remarkable difficulties. Thus, the Mt. Cenis leads from the Rhone valley to Turin; the Simplon and St. Gotthard carry lines to Milan; the Brenner leads to Verona; and the Semmering to Trieste and the Adriatic.

Paris and Berlin are the foci for north-south routes and for the busiest part of the plain, where the railway network is closest; and Moscow is the chief focus in the partially developed eastern part of the plain, where lines are comparatively few. From Paris, a trunk route runs viâ Tours and Poitiers to Bordeaux. Thence it runs along the narrow coastal strip between Bayonne and San Sebastian to avoid the high, narrow, unsurmounted Pyrenean ridges; and crosses the Iberian plateau to Madrid (900 miles). From Madrid it proceeds south utilizing the Guadalquivir valley to Cadiz, the port for Tangiers and Morocco. The main route to Lisbon runs south-west from Medina (124 miles before Madrid); but a line from Madrid descends the Tagus valley to Lisbon. The Paris, Lyons, Mediterranean Railway, the present route of most of the overland mail and passenger traffic between Britain and the Far East, saves six days on the voyage to and from London. From Paris the route is up the Yonne valley, past Dijon and Arles, and down the Rhone valley to Marseilles (540 miles). A branch from Tarascon crosses the Rhone, and passes by Nîmes, Narbonne and the Col de Pertus to Barcelona and the towns of eastern Spain. The main-line continues along the Riviera coast, joining the Italian railways leading to Genoa, Rome, and Naples. Express traffic from Paris to Italy is more direct. It leaves the Dijon-Marseilles line at Maçon; and passes by Chambery and Modane, through the Mt. Cenis tunnel ($7\frac{3}{5}$ miles long), Turin, Genoa and Pisa to Rome (900 miles), and Naples (1,060 miles). From Turin a route passes along the east of the Apennines to Taranto and Brindisi, the mail port for the Far East. Another route from Paris leads from Dijon to Pontarlier; crosses the Jura at the Col de Jougne; descends to Lausanne; follows the Lake of Geneva and the Rhone valley to Brieg; and then crosses the Alps in the Simplon tunnel ($12\frac{1}{4}$ miles long), and proceeds to Milan (550 miles), Venice (720 miles), and Trieste (870 miles). The shortest route from London to Italy is viâ Calais, Amiens, and Chalons, through the Vosges to Basel, and



Routes of Europe

thence by Lake Lucerne and the St. Gotthard tunnel (9½ miles long), to Milan (755 miles). The Orient Express route from Paris to Constantinople ascends the Marne valley past Épernay and Chalons. Then striking eastwards by Nancy and Strasbourg, it crosses the Rhine; runs along the base of the Black Forest; and winds along the Neckar valley, past Stuttgart and on to Ulm. Thence it runs eastwards to Munich and Salzburg; rejoins the Danube valley; and follows that valley past Vienna (870 miles), Pozsony and Buda-Pesth, to Belgrade. At Belgrade the line enters the Balkan valleys; ascends first the Morava valley to Nish (whence it sends a branch line viâ the Vardar valley to Salonika, 1,730 miles); then crossing high ground it reaches Sofia and the Maritza valley, which it descends; and, finally, traverses the plain to Constantinople (1,960 miles). The Baghdad Railway, beginning at Haidar Pasha, may be considered a continuation of this route; and with the establishment of a train-ferry on the Bosporus and further railway construction, there will come a through route to the Persian Gulf from the North Sea ports, and from London when the proposed Channel tunnel from Dover to Sangatte and train ferries from Richborough become realities. Another and shorter overland route to Constantinople is the Simplon Orient route. From Paris the line proceeds viâ Lausanne and the Simplon tunnel to Milan; thence it passes north of Trieste into the Save valley, which it descends to Belgrade, where it joins the longer Orient route.

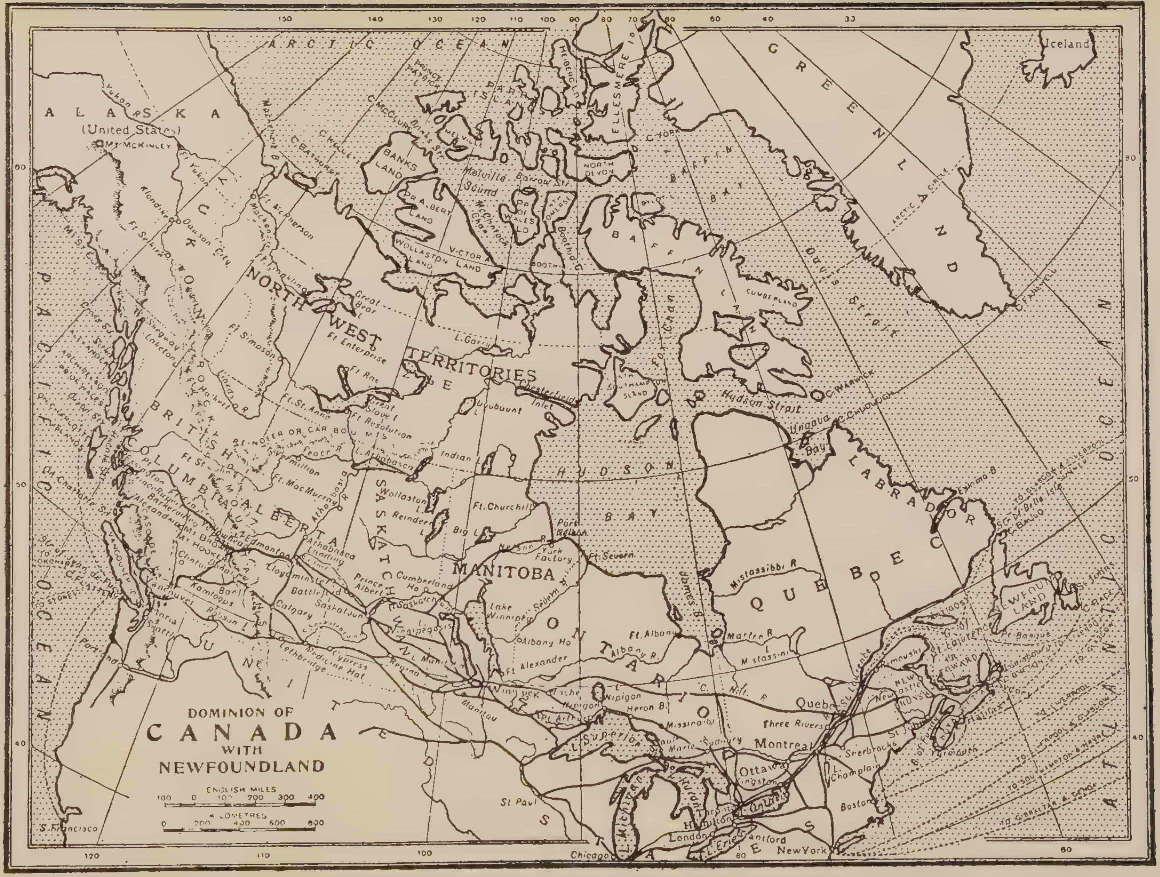
Important trunk routes lead from Paris by the Oise and Meuse valleys and Cologne to Berlin (680 miles). Eastward from Berlin there are three trunk lines. The most northern crosses the Oder and Vistula to Marienburg; runs north-east to Königsberg, thence east to Vilna, and finally north-east to Leningrad (980 miles). The middle route passes through Thorn, Warsaw, and Smolensk to Moscow (1,200 miles); while the southern skirting the northern slopes of the Carpathians leads through Lemberg to Odessa (1,040 miles). Southward from Berlin runs the important Nord-Sud express by Munich and the low Brenner pass to Verona and Venice (800 miles). All the important North Sea, English Channel, and Baltic ports have direct connection with both east-west and north-south routes; and several routes have been straightened by tunnelling. Thus, the Lötschberg tunnel linking Kandersteg with

Leukerbad provides a direct route to Zermatt; and the ten miles of tunnels in the Karawanken and Julian Alps give a shorter connection between Vienna and Trieste. Both Leningrad and Moscow have direct lines to the Trans-Siberian Railway; and, from a point a little east of Samara, a line branches south-eastwards past Orenburg, and runs by the Sir valley to Tashkent, where connection is made with the Trans-Caspian Railway. Southward from Moscow two main routes run to Odessa and Rostov, then on to Baku; from whence another railway, running parallel to the still unconquered Caucasus and utilizing the Suram pass, reaches Poti and Batum.

Copenhagen is connected by rail and train-ferries with Esbjerg, Kiel, Warnemünde, and Malmö. From Malmö a line crosses the lowlands of south Sweden to Stockholm (370 miles), and continuing northward along the Baltic plains reaches Haparanda (1,180 miles). A line from Bergen and Oslo (Christiania), which runs through the difficult mountain country of south Norway (where it traverses 23 miles of tunnels and reaches a height of 4,268 ft.), joins the Malmö-Haparanda route, 135 miles north of Stockholm, and at Boden connection is made with the Lapland railway from Narvik. From Haparanda the route leads to Torneå; whence the Finnish railways skirt the plateau of Finland, and sending branches to the chief ports finally reach Leningrad, after a course of 735 miles. The new line from Leningrad to the northern ice-free port of Murmansk (960 miles), enables Russia to ship produce all the year round. Russia, Finland, Spain, and Portugal have not adopted the standard 4 ft. 8½ in. gauge, and though " break of bulk " of goods in transit may be avoided by means of adjustable wheels on the rolling-stock, delay in carriage is inevitable when change of gauge occurs. This brief survey of European railways shows that railways have made Europe like a steppe which a caravan can traverse in any direction.

North American Railways. The rugged Appalachians, the western cordilleras, and the Great Lakes furnish a very interesting study in obstacles to railway construction. From Denver to the Sacramento the mountain belt, 6,000 ft. in height, is 850 miles in width, and from Calgary to the Pacific some 400 miles. Railways ramify over the plains of the east, south, and centre, the northern routes seeking the Appalachian gaps, and, in several cases, deviating southwards on account of the Great Lakes. Through the western ranges the railways wind considerably, stretching long arms which feel for the lower passes. Very close networks are found in the industrial regions between 40° N. and 50° N., extending westwards as far as the meridian of 100° W. The navigable Mississippi and water routes to Europe caused the first railways to go east-west, and transcontinental lines in this direction have proved vital to the development of the continent and are links in routes from Europe to Japan, China, and Australasia. The railways of the United States are due to private enterprise; but, in Canada, the Dominion Government has assisted railway companies, built several lines, and established its own Canadian National Railways.

The transcontinental railways of Canada—the Canadian Pacific and the Canadian National Transcontinental—as through routes to the Pacific are shorter than those of the United States, and their Atlantic and Pacific termini are in closer proximity to the ports of Europe and Asia respectively. For through traffic to Australasia, however, the lines of the United States, preferably extended to Mexican ports, have the advantage; and New York is nearer to Montreal than St. John or Halifax, so that in winter the quickest route to Canada's heart is by rail from New York. The Canadian Pacific Railway, Canada's first transcontinental line, runs from Halifax and St. John (ice-free ports) across the State of Maine to Montreal. From Montreal it ascends the Ottawa valley; skirts the north shore of Lake Nipissing; passes the nickel district of Sudbury; skirts Lake Superior to Port Arthur and Fort William; and reaches Winnipeg, the nodal point of all east and west traffic. Thence the line crosses the prairies viâ Regina to Calgary; follows the Bow River valley; and near the Kicking Horse Pass (5,300 ft.) of the Rockies reaches its highest point. Leaving the Rockies, the line formerly crossed the Selkirks, but now utilizes the Connaught tunnel (5 miles), and, finally, running along the edge of a precipice in the Fraser valley, and then round the winding shore of Burrard inlet, reaches Vancouver (3,600 miles). The National Intercolonial Railway from Halifax through New Brunswick and along the St. Lawrence to Montreal is longer than that through Maine by 200 miles. The National Transcontinental (formerly the Grand Trunk Pacific) has easier gradients and more modern rolling-stock than the



DOMINION OF
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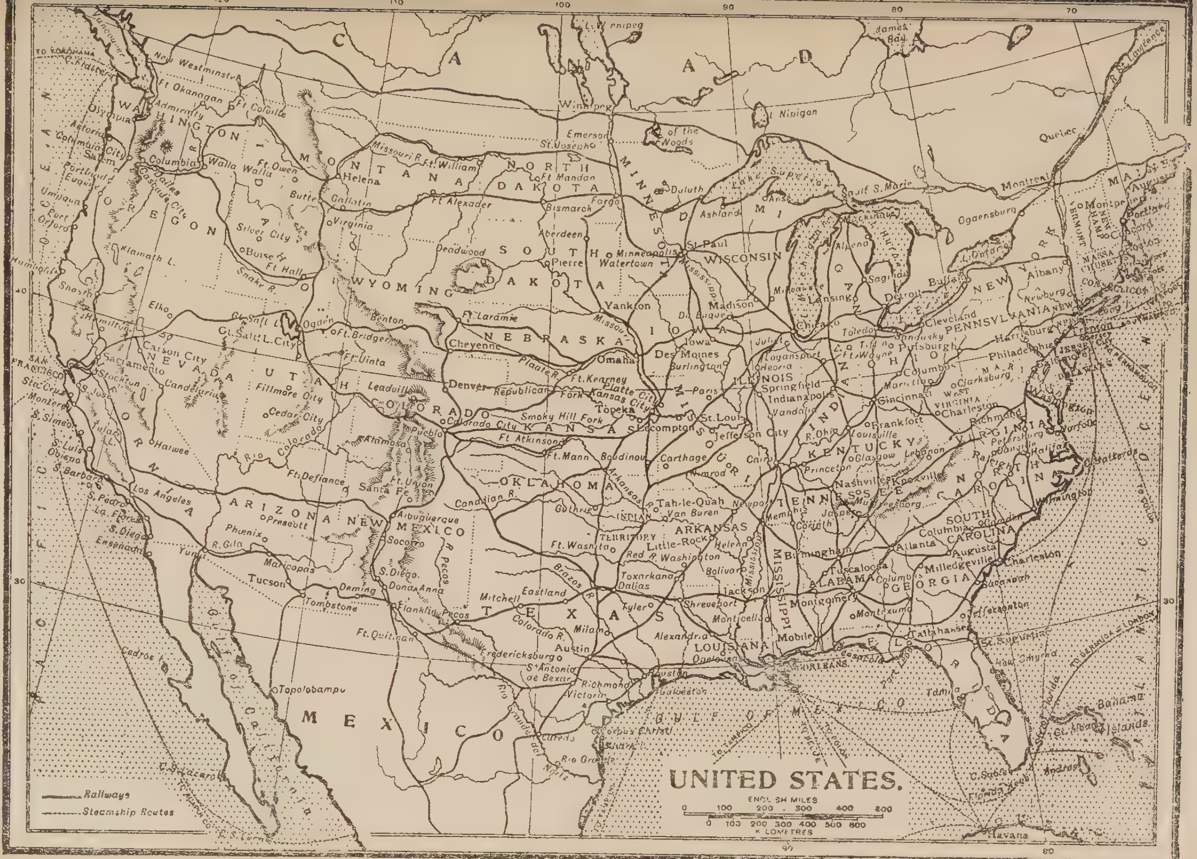
Canadian Pacific. From Winnipeg to Prince Rupert the maximum gradient is 1 in 204, and eastwards it is but 1 in 252. Starting from Moncton, at the head of the Bay of Fundy, the line is compelled to make a circuitous route in order to remain on Canadian territory. From Quebec it proceeds along the plateau north of Lake Nipigon, keeping an almost direct course to Winnipeg; thence it strikes north-west through Saskatoon and Edmonton; and goes over the Yellowhead Pass (3,700 ft.), down the upper Fraser valley, and through a long tunnel to the Skeena valley, down which it runs to Prince Rupert (3,750 miles). The Canadian National Railway (formerly the Canadian Northern) runs from Port Arthur to Winnipeg, keeping south of the Canadian Pacific, and then to Edmonton, north of the National Transcontinental. From Edmonton it crosses the Rockies by the Yellowhead Pass and reaches Vancouver viâ the Fraser valley. This route is to be extended through Quebec and Montreal to St. John and Pugwash (Nova Scotia), to complete a third transcontinental line. At Le Pas the National Hudson Bay Railway makes connection with the Canadian National, and runs to Kettle Rapids (334 miles), and will, eventually, be completed to Port Nelson (424 miles). The Yukon Railway, from Skagway in the Alaskan "pan-handle" to White Horse on the Lewes River, is chiefly in Canadian territory, and is the easiest route to the Yukon and Klondike goldfields.

The eastern trunk railways and the transcontinental roads of the United States give through connections from east to west; and their concentration on Chicago and St. Louis makes these cities the chief railway foci. The New York Central and Hudson River railroad follows the Hudson-Mohawk valley through the region of the Great Lakes viâ Buffalo and Detroit to Chicago (980 miles), the starting point of through lines north-west of St. Paul (400 miles from Chicago), with connections to Winnipeg and Montreal. The Great Northern and Northern Pacific System (under one control) links Seattle, Tacoma, and Portland with St. Paul and Lake Superior; and the St. Paul System connects the ports on Puget Sound with Lake Superior, St. Paul, Milwaukee, and Chicago. By the Great Northern, Seattle is distant from St. Paul 1,820 miles, from New York 3,150. A route from New York crosses the Appalachians, and proceeds through Pittsburg to Chicago and Omaha; whence the

Union Pacific, the first transcontinental railroad constructed in the United States, runs up the Platte valley, past Ogden, and viâ the Great Basin and the Sacramento valley to San Francisco (3,270 miles). Other lines run north-east to Toronto and Montreal (850 miles), and south by the Mississippi valley to New Orleans (910 miles). Philadelphia and New York are linked directly with Chicago by means of the Susquehanna valley in the Appalachians, and a saving of 70 miles is effected over the route viâ Buffalo. From Philadelphia and Baltimore a route crosses the Appalachians by the Potomac valley, and reaches St. Louis, which is connected with the Atchison, Topeka, and Santa Fé System starting at Kansas City. The route traverses the arid lands of Arizona to Los Angeles and San Francisco (3,320 miles from Baltimore), whence a line runs to Portland. A southerly route from Baltimore and Washington leads south-west to New Orleans, and by the Southern Pacific continues westward along the Mexican border to Los Angeles and San Francisco (2,490 miles from New Orleans), making several connections, notably at Laredo and El Paso, with the Mexican railways. From Salt Lake City the Oregon Short Line runs to Portland; the San Pedro to Los Angeles; and the Western Pacific to San Francisco. The Kansas City, Mexico, and Orient route, now nearing completion, will run to Topolobampo, near the mouth of the Gulf of California, furnishing the shortest railway route to the Pacific for a large part of the southern states, and even from the eastern seaboard. In the competition for the transcontinental trade the northern and southern routes are more favourably placed than the central; but the Southern Pacific, although it has the shortest land-carriage, has the disadvantage of crossing the most arid part of the United States. A noteworthy feature of the railways of the United States is the light railroad for electric cars. In the Lake and Prairie states, where there are no very heavy gradients and where suburbs are growing rapidly, the electric railway has reached its highest development. Uniform standard gauge and powerful locomotives are great aids in long-distance haulage, and the negotiation of heavy gradients in North America.

Mexico presents many difficulties in railway construction between plateau and coast, but is not ill-provided with railways. Many lines, however, suffer from gaps in construction which lessen their



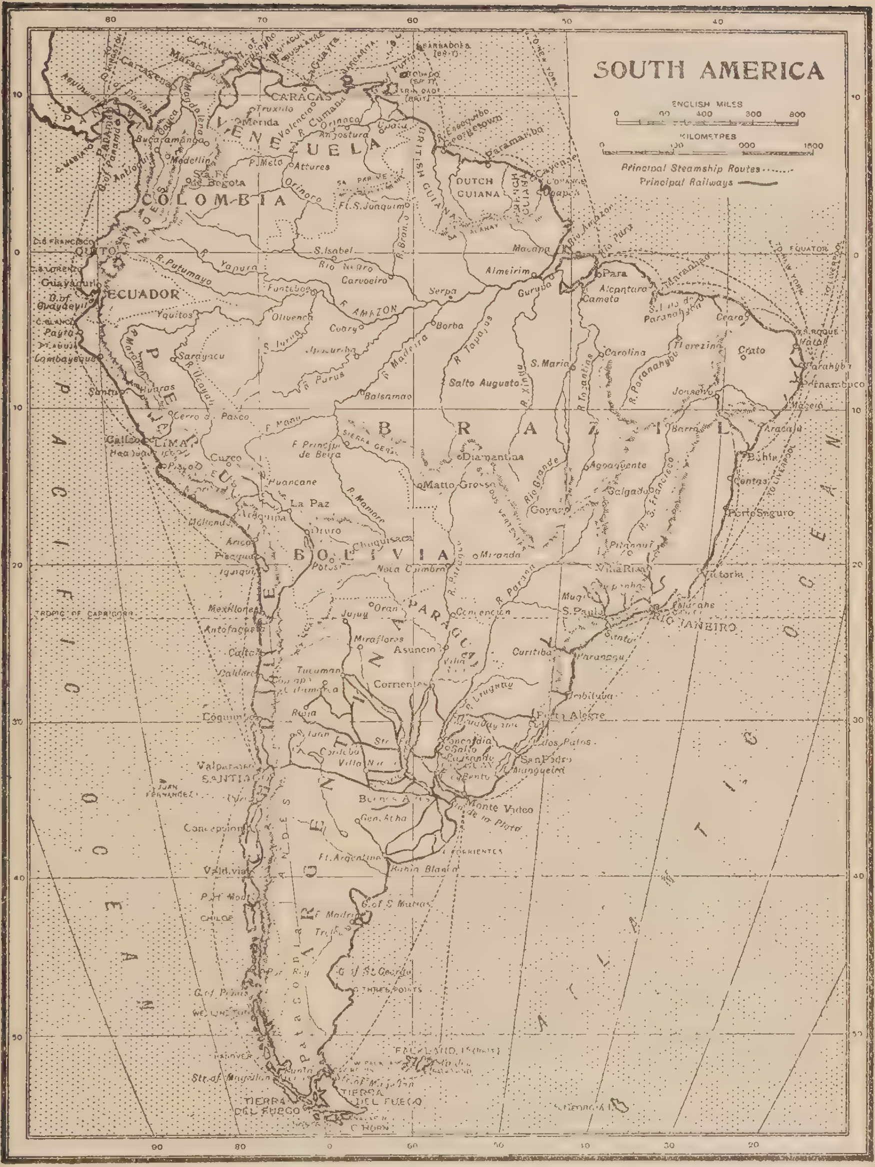
Routes of the United States

value. From Mexico City, railways run north to the railroads of the United States, on the eastern side through San Luis Potosi and Monterey, in the centre through Leon and Chihuahua, and through Mazatlan and Guaymas on the western side. Westwards from the capital lines pass through Colima to Manzanillo, southwards through Puebla to Oaxaca, eastwards to Vera Cruz, and south-east to the Tehuantepec line running from Puerto Mexico to Salina Cruz (192 miles). The route from Topolobampo, north-east across Mexico and the United States through Presidio to St. Louis and New York, lacks two stretches of about 100 miles each to make it a quick route from Europe to Australasia. Railway construction is proceeding along both the Atlantic and the Pacific shores.

Central American Railways. With the exception of the Panama Railway from Colon to Panama (47 miles), the Central American Railways are, as yet, of small importance. Heavy gradients, luxuriant vegetation, and volcanic disturbances, hinder transport; and many gaps occur in the proposed trunk line along the isthmus. The International Railway Company of Central America, however, is making efforts to develop the republics.

South American Railways. South America, like Africa, is one of the undeveloped assets of the world, and this fact has encouraged the expenditure of European (and especially British) and American capital on South American railways. Railway routes encounter the physical obstacles of high plateaux and mountains, swamps, jungles, and unhealthy coastal districts; traverse lands of differing and often unstable political control; and show, unfortunately, owing to each republic developing its own railway system without regard to those of its neighbours, no less than fourteen differing gauges, ranging from 1 ft. 8 in. to 5 ft. 6 in., the metre gauge being the commonest. Interconnection between the republics is, therefore, particularly difficult. Population is peripheral, and so the main work of the railways is in linking seaports with their hinterlands. Argentina and Chile show the most progressive railway-building. As in Africa, a through route, a Pan-American railroad, has been proposed, to link Alaska to Buenos Aires and beyond, but the probability seems remote.

The only transcontinental line runs from Buenos Aires to Valparaiso (890 miles). On the Argentine pampas and Chilian



Routes of South America

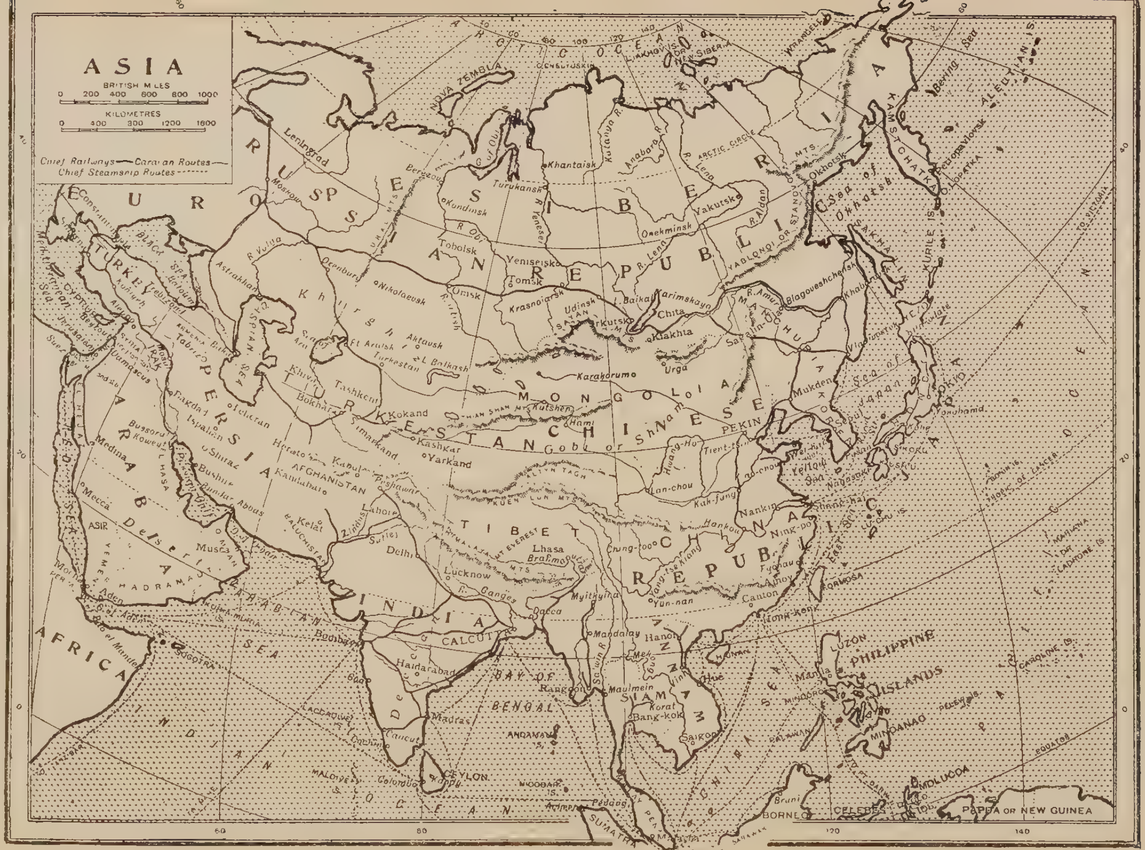
lowlands, which form over two-thirds of the route, the gauge is 5 ft. 6 in. ; but in the Andes the metre gauge is employed, necessitating the Abt system. By zigzag courses, in the Andean valleys, the railway attains a height of about two miles ; tunnels under the Upsallata Pass ; and descends the steep Chilian slopes in a series of screw-shaped tunnels. A line which is nearly complete across the continent starts from Buenos Aires ; proceeds north-west by Rosario and Tucuman to Jujuy (940 miles) ; skirts the Andes to the west and the wild Chaco to the east ; and reaches the Argentine frontier at Quiaca by a stiff gradient, where rack sections are necessary. From the frontier, a short gap of some 120 miles is being constructed to link the Argentine railways with those of the Bolivian and Peruvian highlands and their western coastal connections. From Rio de Janeiro, main-lines extend north to the San Francisco valley (625 miles), north-west to the Paraguay valley, and south-west to Montevideo (1,980 miles), from whence a route running parallel to the ocean coast sends branches to every important harbour on the coast. North from Rio de Janeiro there is a railway through the diamond district to Bahia, and thence to Joaseira ; and further north Theregina is joined to San Luiz. The only railway in the Amazon valley is one of about 200 miles, past the rapids on the Madeira River, from Porto Vello to Guajaro Merim. From Asuncion, the capital of Paraguay, a line proceeds south-east to the Parana (230 miles), and by train-ferry trains reach Posados, whence an Argentine line goes south to Buenos Aires. Argentine railways spread out in all directions from Buenos Aires, but stop in the south at about lat. 40° ; and in the south-west at the edge of cultivation in the Andean uplands (except the Trans-Andine). An existing line from Bahia Blanca, due west to Neuquen, is planned to reach the Chilian coast at Concepcion. Chile completed in 1914 her longitudinal railway, which runs from Iquique (lat. 20° S.) to Puerto Montt (41° S.), a distance of 2,000 miles. It has connections with all the principal ports, but breaks in gauge hinder transport. La Paz, the Bolivian capital, is connected by rail with Arica, and through Lake Titicaca with Mollendo ; while the principal line runs from La Paz through Viacha and Oruro to Antofagasta in Chile. A branch from Potosi joins the main line at Rio Mulatos. Eastwards, from Oruro a line will meet the railways of Brazil, and another line from Potosi will join the Argentine System at Quiaca. Cerro de Pasco, the chief mining centre of Peru, is connected by a railway of remarkable height (15,600 ft. at its summit) and difficulty with Lima, Callao and Oroya, from which point a line will eventually reach Ayacucho. Another Peruvian line runs from Mollendo through Arequipa to Puno and Cuzco. The only important railway of Ecuador runs from Guayaquil to Quito (370 miles). Narrow-gauge railways, few and of little commercial importance, have been built in mountainous Colombia and Venezuela. The difficulties of the routes are clearly shown in the line from Carácas to La Guaira, its port (8 miles), which zigzags for more than 20 miles over the mountains.

Asiatic Railways. Asia, the seat of ancient civilizations, the continent of enormous distances, and of the oldest extended commerce, is yet an infant in modern transport; her peoples are but beginning to grip the tools and mechanism of the West. The great mountain system of the centre will probably for ages compel railways to go round the high plateaux; and vast deserts, swamps, wide rivers, and Arctic ice are serious obstacles to railway transport. Vast areas still lie undeveloped, and caravans, although on the wane, carry much of the traffic of interior Asia. Uniformity of gauge is absent; and only one transcontinental line is in existence. Railways, however, are steadily increasing, and a rapid industrial revolution is probable in China, as railways grow and Western methods are adopted.

The Siberian transcontinental line, now being relaid and double-tracked, follows the military road and the ancient trade route between Russia and the Far East. Its Pacific termini are Port Arthur, Tairen (Dalnyi) and Vladivostok; from which points Moscow (5,500 miles approximately) is reached in normal times in about nine days. The rivers Obi, Yenisei, and Irtish, which serve as feeders for north and south traffic, are spanned by huge bridges, 2,000 to 3,000 ft. long. Two lines, one from Leningrad and the other from Moscow, join at Chelyabinsk, and thence the route, double-tracked as far as Kaidalova, runs through Omsk to Novo Nikolaievsk, whence the Altai Railway goes southward to Barnaul and Semipalatinsk. After crossing the Obi at Krasnoyarsk, the line follows the Angara valley to Irkutsk; curves round the south of Lake Baikal; and ascending from the lake reaches Tchita. Descending into the Amur basin the line divides into two branches at Kaidalova (near Tchita). One branch, the original line, strikes south-east, leaves the Amur valley, and crosses the high bleak plateau of Chinese Manchuria to Vladivostok. The other branch follows an all-Russian route to the Pacific; crosses the Amur at Khabarovsk by a bridge 1¼ miles long; and then descends the Ussuri valley to Vladivostok. At Kharbin, in Manchuria, a southern branch passing through Mukden to Port Arthur is connected with the Chinese railways. Gradients on the western section of the line as far as the Obi are easy, nowhere exceeding 1 in 135. Further east, however, they rise to 1 in 66. The Siberian Railway is the one real artery of the country, the link by which the west keeps in touch with the east. It has promoted settlement, and on it depends future settlement. It is a very valuable quick route for passengers and mails between Europe and the Pacific, normally, bringing Vladivostok within 12, Pekin within 14, and Yokohama within 16 days of London; whereas the sea route to Japan involves six weeks. As a carrier of through freight, however, its value lies only in the transport of valuable products, such as silk, tea, machinery, and furs; and several branch-lines are needed to develop the mineral and agricultural resources of Siberia and Manchuria. The Trans-Caspian Railway, part of a possible route between Europe and India, and a present trunk route for interior Asia, runs from Krasnovodsk on the Caspian for 1,200 miles through Merv, Bokhara, and Samarkand to Andijan with branches to Tashkent and Kushk on the Afghan frontier. Afghanistan has no railways; and, as yet, political complexities and engineering difficulties prevent the railway connection of Kushk with Quetta, to complete the through route from India to Europe. Recently, the railway has reached Persia. A branch from the Baku-Black Sea line passes through Armenia to Tabriz in north Persia. A prolongation of this line, through Teheran and Seistan to Quetta and Gombrun, would bring London within a week of India.

The most important Chinese railway will probably be the present north and south trunk which links Tientsin to Pekin and Hankow, and is to be extended through the Cheling Pass and Pei valley to Canton. From Tientsin a line goes to Mukden (520 miles) and connects with the south Manchurian railway and the Siberian system. Tientsin is also joined to Shanghai. From Pekin a line goes north-west to Kalgan, and will be extended along the old tea-route to Urga, Kyakta, and the Siberian Railway. Yunnan-Fu was reached in 1910 by a French railway (450 miles long) from Haiphong on the Gulf of Tonquin. Across Yunnan are the shortest land routes between India and China. From Canton to Calcutta viâ Yunnan is 1,600 miles ; by sea the route is 4,000 miles. A great trunk railway may assume shape joining Canton with the European system at Constantinople, the African at Cairo, and the Russian at Kushk. In Japan the railway has preceded the road system. The Japanese railways are mostly coastal ; a few lines only penetrate and cross the country by the scanty through valleys. A line runs from Kagoshima, in Kiushiu (with branches to Nagasaki and Sasebo), to Moji. From the opposite port, Akamagaseki, in Honshiu, another line traverses the south and east coasts to Aomori, connecting Kobe, Osaka, Kioto, Nagoya, Yokohama, Tokio, and Niigata. In Hokkaido a line from Hakodate runs into the interior through Saporo and the Poronai coal-field. Japan is now planning a large scale electrification of her railways.

A trunk-line, in the Malay peninsula, joins Singapore, Penang, Bangkok and the upper Menam valley, saving 4½ days over the sea-journey from Singapore to Bangkok. From Rangoon the Burma Railway runs up the Irawadi to Prome (with branch to Bassein), and up the Sittang valley to Mandalay, Wuntho, and Myitkyina (800 miles). Four gauges are used on the Indian railways, ranging from 2 ft. to the standard 5 ft. 6 in. The direction of the routes depends largely on the build of the country, the main routes radiating from the western ports of Karachi, Bombay, and Goa, and the eastern ports of Madras and Calcutta. The Ganges System runs from Calcutta to Patna, Benares, Allahabad, Lucknow, Agra, and Delhi. The North-Western is the carrier of the Punjab traffic, and links the Ganges System through Amritsar and Lahore with the Indus-Karachi System, which has a branch running to Quetta and the Afghan border. Further north the railway reaches Peshawar. From Bombay, lines run north through Baroda and Ahmadabad to Delhi ; through Jabalpur to Allahabad ; through Nagpur to Calcutta ; and

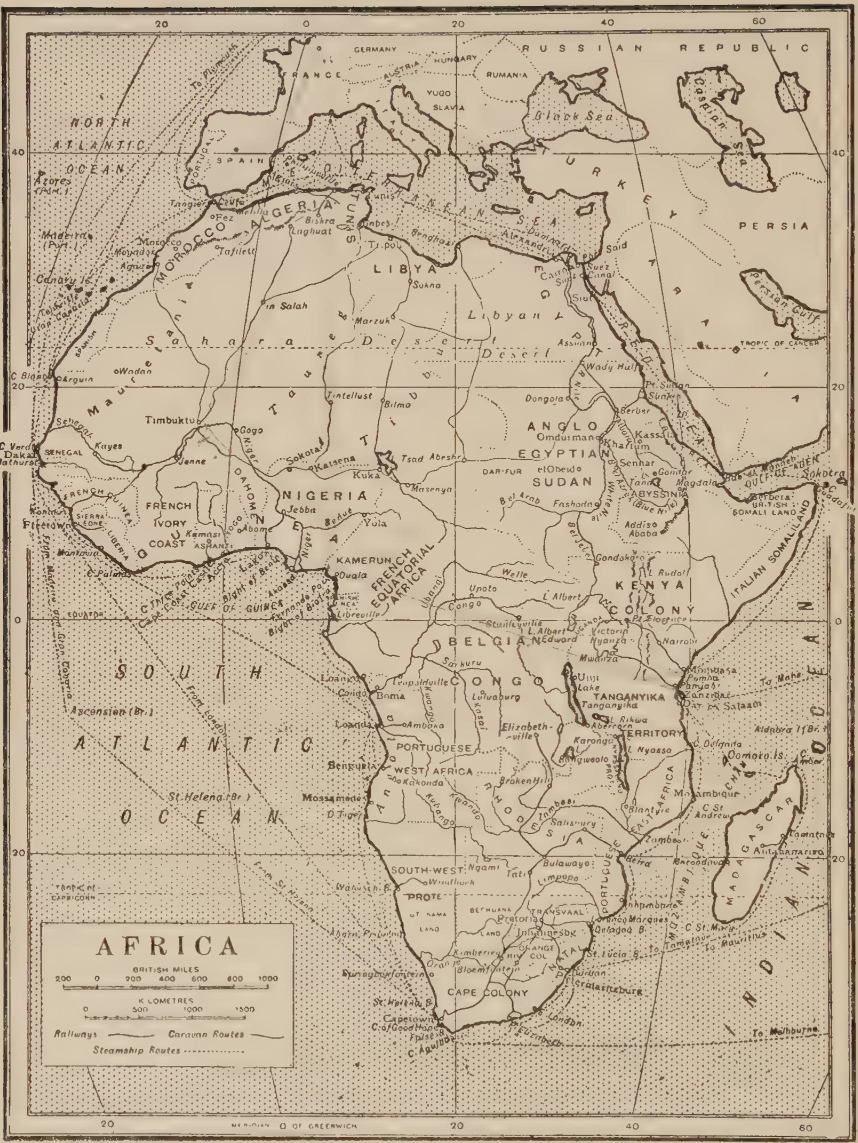


ROUTES OF ASIA

through Poona to Madras. Goa is joined to Madras, and from Madras to Calcutta the eastern coastal plain is traversed completely. From Chittagong a line runs to Sadiya, and is being connected with the Burmese system. Through rail connection with Ceylon is interrupted by Palk Strait.

Caravan routes through the desert and arid countries of central and south-west Asia are still important links in the trade between India, China, and the Near East; though a few railways have been built or are projected along some of the routes. Between the Persian Gulf, Irak (Mesopotamia) and the Levant, the Baghdad Railway (nearly completed) is supplanting the caravan traffic. This line, conceived and built largely by German enterprise, has a gauge of 4 ft. 8½ in. From Haidar Pasha (near Scutari) or Smyrna the line runs to Aleppo (some 840 miles), overcoming the difficulties of the Taurus range by means of four tunnels, and sending branches to Mersina and Alexandretta. At a junction 8 miles north of Aleppo, the main-line continues eastwards; crosses the Euphrates at Jerablus; reaches Nisibin near Mosul; and will, eventually, follow the Tigris valley to Baghdad (1,500 miles from Constantinople). From Baghdad the line is completed down the Tigris valley to Basra (1,800 miles from Constantinople). It is claimed that London will be reached in six days by express train from Basra. A line is projected frcm Basra along the northern shorelands of the Persian Gulf viâ Bushire and Bandar Abbas to Karachi. Through Aleppo the Syrian railways join the Baghdad line; and from Rayak junction (branch to Beirut) lines proceeding south and south-west change to 3 ft. 5·3 in. gauge. At Damascus (branch to Haifa), the Hedjaz Pilgrim Railway runs for 820 miles eastward of the Jordan rift valley through the desert to Medina, whence it will finally reach Mecca. Jaffa has railway connection with Jerusalem; and Egyptian railways are now connected with the Syrian by a route which crosses the Suez Canal by means of a swing bridge, and runs through the Sinai peninsula.

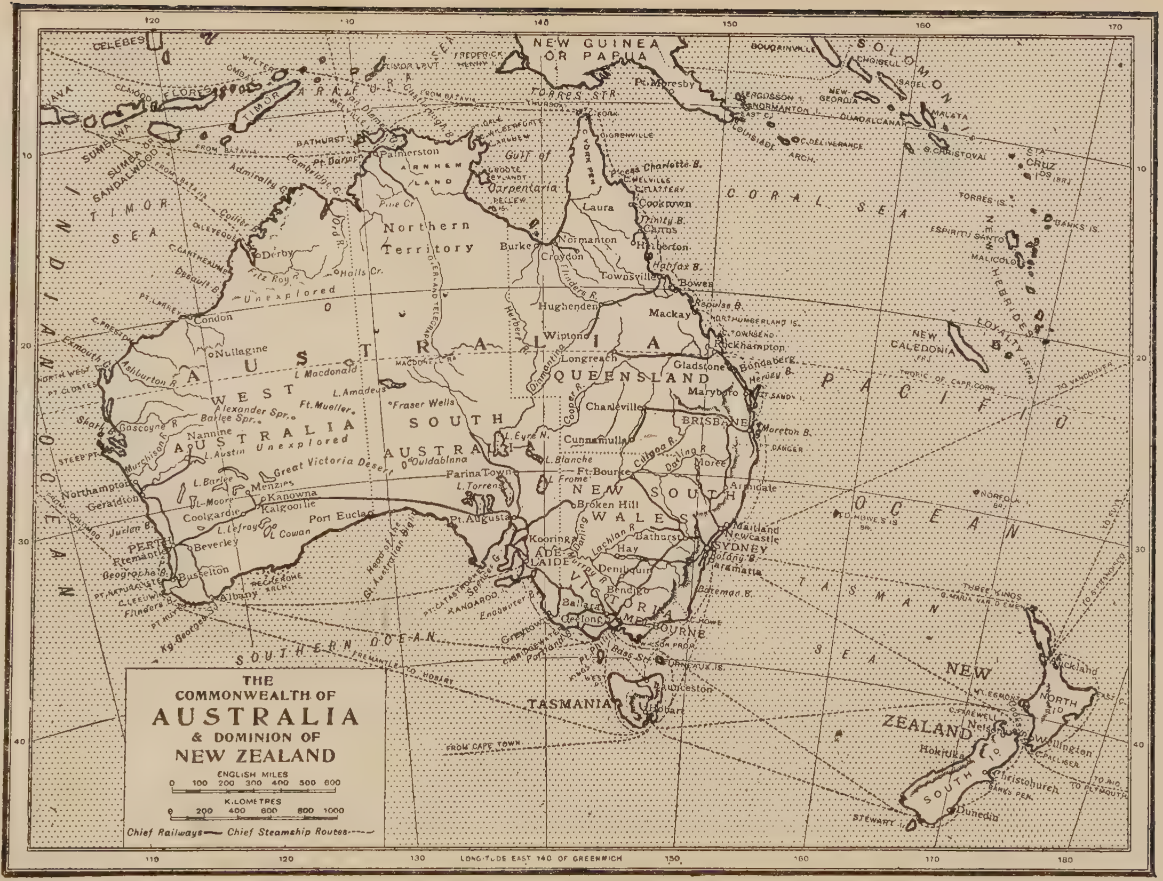
African Railways. The plateaux of Africa backed by bordering coastal mountains, the newness of the major portion of the continent in commerce, the tropical swampy malarial coastal plains, the vast deserts, and the almost impenetrable forests, account for the



ROUTES OF AFRICA

small railway mileage. Railway construction has taken two forms: lines from the ports into the interior (sometimes in advance of trade), and lines linking up navigable stretches of rivers. The principal gauges are the 3 ft. 6 in. and the metre gauge on account of the heavy gradients and the comparatively small volume of traffic. Transcontinental lines are absent; nor is there need for them, although the modern development of Africa has been and is bound up with railway construction. Some idea of the difficulty of building railways from the coast to the interior plateaux may be gained from the facts that on the South African railways there are several gradients of 1 in 35, curves of 300 to 350 ft. radius, and heights of 6,000 ft. to be attained.

The much-discussed south-north Cape to Cairo route, a distance of nearly 7,000 miles, unlike the east-west routes of the northern land hemisphere, will connect no great ocean routes; and for through traffic, with the exception of mails and passengers, will be of little importance, as the railway will, for most of its length, be paralleled by the cheaper ocean route. Its main function will be to connect a number of shorter lines coming from the eastern and western ports, which will bear the main traffic. The routes of Africa are, in several cases, water routes by river and lake, connected here and there by railways; and it seems a more practicable plan to make use of Nile and lake navigation in the Cape to Cairo scheme than to make an all-rail route. Alexandria and other delta ports have railway connections with Cairo, from whence a main line runs up the Nile valley to Aswan, break of gauge from 4 ft. 8½ in. to 3 ft. 6 in. occurring at Luxor. From Aswan to Wadi Halfa the navigable Nile replaces the railway, which, however, proceeds from that centre to the third cataract. A more important line crosses the desert to Berber (with a branch to Suakin and Port Sudan, 310 miles), and continues to Khartum (1,250 miles from Cairo), Sennar and El Obeid. From Cape Town the route is constructed viâ De Aar, Kimberley, Mafeking, Bulawayo, and the Victoria Falls to Bukama in the Belgian Congo. South Africa has a railway network in the making. Trunk-lines proceed from Cape Town and the East coast ports into the heart of Africa, and, as already mentioned, railhead has reached Bukama (2,700 miles from Cape Town viâ Bulawayo). A shorter route than the present circuitous one between Beira and



THE COMMONWEALTH OF AUSTRALIA & DOMINION OF NEW ZEALAND

Rhodesia is being made, and a line from the navigable Zambesi is nearing Lake Nyasa.

Railways, helping to overcome the difficulties to navigation on the Congo and its tributaries, are those from Matadi to Leopoldville (250 miles), from Stanley Falls to Ponthierville (80 miles), from Kindu to Kongolo (220 miles), and from Kabalo to Albertville (170 miles). Important routes from the eastern coast into the interior, involving heavy gradients, are the Abyssinian Railway from Jibuti to Addis Abeba (500 miles); the Uganda Railway from Mombasa to Port Florence (590 miles); and the line (formerly German) from Dar-es-Salàm to Kigoma, near Ujiji (780 miles). Lüderitz Bay and Walfisch Bay have railways into the interior. In Angola a line from Lobito is destined to reach the Cape Town-Bukama line, and form part of a trans-African route, planned by the French and Belgians, to proceed down the Congo as far as it flows north, past Lake Chad, across the Sahara to Figig, and on to Tangier. The crossing of the Sahara by the Citröen expedition in caterpillar motor-cars brings the scheme within the range of practicability, and should direct sun-heat be made available for power purposes a great difficulty will be removed.

In West Africa, railways are complementary to river routes. Several lines from the coast penetrate the interior; and important lines connect the navigable portions of the Niger and Senegal, and Lagos with Kano (700 miles). From Fez, the capital of Morocco, a line joins several of the coast towns, and is projected to reach the railways of Algeria and Tunis, which are chiefly coastal, but send short branches southwards into the interior. Western projections of the Egyptian railways will, eventually, reach Tunis, and thus help the completion of a northern transcontinental line.

AUSTRALASIAN RAILWAYS. Much of Australia is arid and semi-arid, and so until man attains higher powers much of the continent will remain undeveloped. The civilized population is mainly peripheral, the east, south-east, and south-west coasts showing the densest population. The Federal and State railways, therefore, are chiefly coastal, pushing branches into the interior and thus connecting mining, pastoral, and agricultural regions with their seaports. There is one transcontinental line, which has overcome remarkable desert difficulties. Its importance is great for political purposes and for passenger and mail traffic, though not for through goods traffic. The most common gauges are 5 ft. 3 in., 4 ft. 8½ in., and 3 ft. 6 in.

The State capitals are noteworthy port-railway foci, and all are connected with each other by rail. The Trans-Australian Railway, opened in 1917, runs from Perth (branch to Fremantle) through Kalgoorlie to Port Augusta (1,425 miles). At Port Augusta connection is made with the older railway system, which runs to Adelaide (1,685 miles), Melbourne (2,170 miles), Sydney (2,760 miles), and Brisbane (3,480 miles). Another transcontinental line, partially constructed, proceeds north from Port Augusta to Oodnadatta (480 miles); and, from Darwin in the north, the line has been built as far as Katharine (200 miles). The chief routes from the coast into the interior, usually over heavy gradients, are the Queensland routes—Townsville to Cloncurry, Rockhampton to Longreach, Brisbane to Charleville and Cunnamulla; the New South Wales routes—Sydney to Bourke and Cobar, Sydney to Walgett, Sydney to Hay; the Victoria routes—Melbourne to Swan Hill, Melbourne to Mildura; the South Australian routes—Adelaide to Port Augusta, Adelaide to Broken Hill; and the West Australian routes—Perth to Albany, Perth to Geraldton, Geraldton to Meekatharra and Sandstone. Canberra, the Federal capital, is joined to the New South Wales System, and will be connected with its future port on Jervis Bay. In Tasmania, the main-line from Hobart to Launceston and Hazlewood has branches to the mining and agricultural regions.

The main railway routes of North Island, New Zealand, are from Wellington north-east to Napier, north-west to New Plymouth, and north to Hotso, near Auckland. In the South Island lines run from Invercargill through Dunedin, Oamaru, Timaru, Christchurch, and Lyttleton to Mackenzie, with branches to the north and west; and from Nelson to Greymouth and Hokitika. A line across South Island has been completed through the Otira tunnel under the Southern Alps connecting the west coast collieries with Christchurch.

RIVER AND CANAL TRANSPORT.—Water has played its part in all ages in providing an easy way for cheap and often long-distance transport of goods and men. Man has progressed from the frail boat of a primitive age to the modern leviathan of 50,000 tons or more, and from the early local market to the world market of to-day. To navigate a slow-flowing river needs little skill or experience in boat-building, and rivers were the world's earliest highways. Primitive man devised means both for down- and up-stream navigation, by dug-out, simple boat, or birch-bark canoe, and the evolution of the sail naturally followed. Every race has its own type of boat and sail adapted to its own peculiar needs. Before the introduction of modern roads and steam railways, river navigation was of much greater importance than it is to-day. Yet rivers still serve as the means of conveying goods to and from the ports of a country; help, when sufficiently long and deep, to open continental interiors to modern commerce; and tend to keep down rates on competing lines of railway. Several factors determine whether rivers can be used as trade routes. Among these may be mentioned the productivity of the regions through which they flow, convenient depth of water, freedom from ice, and absence of bars at their mouths and waterfalls and rapids in their courses. Few rivers are naturally navigable for sea-going vessels; often dredging, blasting, and canal and railway construction are necessary to complete the chain of transport. Canals, as a means of land communication, are constructed to improve navigation on rivers, to avoid obstacles, to link rivers, and to provide a waterway where no river exists. Their advantages are cheapness for heavy goods and the small cost of repairs; their disadvantages are slowness and the difficulty of mounting slopes. Canals have lost much of their old importance, and need revival; but it should be borne in mind that it is only for long journeys that they can beat railways for transport purposes; a fact which partially explains the decay of many British canals and the success of several continental canals. Physical factors are of great importance in the construction of canals. Over level plains the cost is small, and few locks are usually necessary. Elsewhere, locks add to the expense and cause delay in transit.

Waterways of Europe. Most of the canals of Europe are in France, Germany, Holland, and Belgium, where both river and canal waterways are kept wide and deep enough to allow steam or petrol tugs to pull a train of barges. All the main canals of France are at least 6½ ft. deep, while the smallest locks are 126 ft. long and 17 ft. wide, thus being capable of accommodating at one time a whole train of barges, each unit of which is big enough to carry nearly 300 tons.

Few English canals can take a barge drawing 4 ft. of water, and few locks can accommodate a tug drawing four barges of 45 tons' burden each. Many Belgian canals take barges of 200 tons; while, in Germany, the canalized Elbe, Weser, and Oder are used by boats of 500 tons propelled by their own engines. The Rhine and its tributary, the Main, furnish the principal waterway of western Europe. Cologne is reached by light-draught sea-going vessels, and tugs and barges use the river as far as Basel, 500 miles from the mouth. Barge canals link Strasbourg with the Marne, Doubs, and Rhone. The delta of the Rhone prevents navigation. Recently, however, a canal of maximum depth of 10 ft. was opened between Marseilles and the Rhone at Arles, and the French propose to improve the navigation of the Rhone to permit vessels of a thousand tons to reach Switzerland, and the products of the Saar and Alsace to be carried to the Mediterranean. The Elbe and the Oder, international waterways, are both navigable for long distances; the former to Prague in Czecho-Slovakia, the latter to Kosel in Silesia. There is canal connection between the two rivers, and the Czecho-Slovak Government intends to connect the Danube and the Elbe to form a continuous waterway through their country from Hamburg to the Black Sea. The international Danube, the finest waterway in Europe, is used by sea-going vessels as far as the Iron Gates, and by small river steamers to Ulm in south-west Germany. For world trade it is little utilized owing to its eastern outlook. Its tributaries, the Tisza, Drave, and Save, are important waterways. Danube navigation is linked by barge canals with that of the Rhine and the Oder, and there is a project for a deeper Danube-Rhine canal. The German Dortmund-Ems canal affords an outlet for the Westphalian industrial area through German territory, and has lessened the trade on the Rhine route to Rotterdam.

Russia is well furnished with many deep slow-flowing rivers, which have been connected so easily with each other by canal that vessels of 1,000 tons burden can pass from the Caspian Sea to Leningrad and Kronstadt. It was the rivers that helped to form the Russian political unit, and compensated partially for the lack of roads. To-day, though marred by tortuous courses, shifting sandbanks, ice-bound nature in winter, and inland sea outlets, they are important in this land of great distances and poor railway development. The Volga is the best waterway in spite of the fact that it opens to the isolated Caspian. The Don and the Dnieper are fit only for shallow-draught vessels, and the Arctic rivers are mainly used as routes for timber exports. The rivers of Norway and Sweden are used chiefly for water-power and the floating of timber; while the rivers of the Mediterranean lands are of little use in commerce.

Waterways of Asia. The chief commercial rivers of Asia are those of China and India; those of Siberia run from south to north, through lands largely undeveloped, to the almost useless Arctic. Ocean steamers ascend the Ganges delta to Calcutta, and river steamers go as far as Allahabad. The Indus and its tributaries are difficult to navigate, and are little used by steamers. River steamers can navigate the Irrawaddi as far as Bhamo over 900 miles from the sea. Chinese rivers have been for centuries the chief highways of the country. The Yangtse is the most important river. It is utilized by ocean-going vessels as far as Hankow, 680 miles from its mouth, while river steamers can ascend it for 1,000 miles, and boats, in spite of the rapids, can go 400 miles further. The Grand Canal, between Hangchou and Tientsin, the port of Pekin, connects the lower Yangtse and Hwang rivers. Constructed in the seventh century it has been used to some extent ever since, though its depth is in few places more than 6 ft. The Hwang river is swift, liable to floods and changing courses, and is, therefore, of little use for navigation; but the Pei-ho and its tributaries form an important means of communication across the northern portion of the plains, and join Pekin to Tientsin. Tributaries of the Yangtse and the Sikiang afford easy communication between Canton and northern China. Of the large Siberian rivers, all of which are frozen or unnavigable on account of drifting ice from about November to May, the Obi is navigable by river steamers to Biisk, 2,300 miles from the sea, and its tributary, the Irtish, to the Chinese frontier. The Yenisei has 2,045 miles, the Lena 2,700 miles, and the easterly-flowing Amur with its main tributary, the Shilka, 2,000 miles of navigable waters.

Waterways of Africa. The rivers of Africa, though impeded by cataracts, have always been the main highways, and will probably always be of first importance. To perfect the chain of communications, railways have been built to link navigable stretches and to circumvent rapids, falls, or circuitous détours of the rivers. The Nile is navigable as far as Gondokoro in Uganda, but at low water its cataracts are impediments, and the seaports at its mouth are not easy of access through the channels of its delta. South Africa is poorly endowed with navigable waterways. The Zambesi is navigable to Tete, 250 miles from its mouth, and its upper reaches and those of its tributaries can be navigated ; but the Limpopo has only a short navigable stretch and the Orange cannot be navigated. The Congo system, apart from the interruptions occasioned by the falls on the plateau and from the plateau to the coastal plain, furnishes a magnificent series of waterways. From Matadi to Leopoldville a railway obviates the impediment to navigation between Matadi and Stanley Pool. Vessels ply from Stanley Pool up the main stream about 1,000 miles to Stanley Falls, whence a railway runs to Ponthierville. Navigation is then continued for 200 miles to Kindu, from which a railway proceeds to Kongolo. From Kongolo steamers can reach Kabalo on the Lualaba, whence a railway runs to Albertville on Lake Tanganyika, thus making connection with the navigation of the great lakes. Tugs and barges from Kabalo ascend the Lualaba to Bukama on the Rhodesian railway. The Ubangi, the chief right bank tributary of the Congo, is navigable almost to its head. In West Africa, the Niger can be ascended to the Bussa rapids, and many of its upper reaches are navigable. The Benue is accessible to Yola and the Gambia for 200 miles from its mouth.

Waterways of Australia. Australia is peculiar in its lack of navigable rivers. Its single great river system, the Murray-Darling, has the defects of intermittent water supply, and a bar at its mouth. Under the most favourable conditions the Murray can be navigated for about 1,400 miles from its mouth, and the Darling for 1,200 miles.

Efforts are now being made to improve the navigation of the Murray and Murrumbidgee by constructing locks and reservoirs on the lower courses of the Murray, which will keep up the water level in the periods of drought.

Waterways of North America. The waterways of North America—river, lake, and canal—have been prime factors in the colonization and development of the continent, and are still of great importance. The Great Lakes, five in number, with the St. Lawrence River, and supplemented by a series of short canals to overcome the various rapids, form a system of internal navigation not rivalled in any other continent. From the Strait of Belle Isle, to Fort William on Lake Superior, the water-route exceeds 2,000 miles. Before the St. Lawrence was dredged, no vessel drawing over 12 ft. could depend on reaching Montreal from the sea. Now, there is a depth of 30 ft., which will eventually be increased to 40 ft. From Montreal the traffic is conducted by lake steamers, the St. Lawrence canals accommodating nearly 14 ft. navigation. The Lachine Canal leads to Lake Ontario, and the Welland Canal by a series of 26 locks enables vessels to avoid the Niagara Falls and ascend to Lake Erie. From Lake Erie the route proceeds by the Detroit River, Lake St. Clair, the River St. Clair, and Lake Huron to the rapids of Sault Marie, which are avoided by the Soo Canals leading to Lake Superior. Unfortunately, all the lake ports are blocked with ice from about the first week in December to the fourth week in April, and navigation then becomes impossible. An enormous volume of traffic in cereals, timber, coal, and ores is, however, carried on during the seven or eight months of possible navigation. Through the Soo Canals alone there passes more than four times the volume of traffic that goes through the Suez Canal. The Erie-Mohawk-Hudson canal and river route links the lake system to the United States' seaboard, and is joined to the St. Lawrence by the Champlain Canal. Proposals have been made (but not adopted) to improve further the water connections with the western plains by deepening the canals to 20 ft., and thus making them available for larger ships, and shortening the routes by the construction of a new canal. From Georgian Bay, on Lake Huron, the proposed route is viâ Lake Nipissing to Ottawa, whence the Ottawa River is navigable to the St. Lawrence. Of the total distance of over 400 miles, less than fifty would be artificial, and there would be a saving of 300 miles on the present route by Lake Erie.

The Mississippi River suffers from heavy floods, shifting channels, southward course, and delta at its mouth, but is navigable by light-draught river steamers as far as St. Paul, while its important tributary, the Ohio, is navigated into Pennsylvania. The Missouri, in spite of great floods, can be navigated almost to the foot of the Rockies; and the whole Missouri-Mississippi system furnishes over

10,000 miles of navigable waters for the greater portion of the year. The recent proposals for the improvement of the Ohio, Missouri, Mississippi, and Illinois waterways, and to provide a deep waterway from the Great Lakes to the Gulf of Mexico, have largely been abandoned, and dependence placed upon the railways. On the Pacific coast the Columbia is open to vessels for some 250 miles, and the Yukon for about 1,500 miles during the summer months.

Waterways of South America. On its eastern side, South American water-routes are navigable for long distances from the sea. The Amazon system, the longest, comprises 50,000 miles of safe navigation in the wet season, and some 20,000 in the dry season. Ocean-going vessels reach Iquitos, 2,300 miles from the Atlantic, and under favourable conditions can go 500 miles further up-stream. The Madeira, in the wet season, can be ascended by large draught steamers to Santo Antonio, 1,500 miles from the sea, and above its rapids, now circumvented by a railway, the river provides another 500 navigable miles to Santa Cruz. The Tapajoz is navigable for 200 miles, the Purus for about 1,000 miles, and, doubtless, other tributaries have navigable stretches suitable for river steamers. Excellent as are the Amazon waterways they are of relatively little use for the selvas are unconquered, undeveloped, and largely unexplored. The Orinoco is navigable for sea-going vessels for about 150 miles, and for river steamers for another 650 miles. There are long navigable stretches on its tributary, the Meta, and on the Magdalena and Atrato.

The Parana system, which penetrates the heart of the Argentine, Paraguay, Uruguay, and southern Brazil, is the most important in the continent. Large draught steamers can ascend to Santa Fé, and river steamers to Asuncion, 940 miles above Buenos Aires, and Concepcion. Small vessels navigate the upper Parana as far as Posados, and on the Uruguay sea-going vessels reach Paysandu, and river steamers go beyond Salto.

OCEAN TRANSPORT.—Ocean routes are determined by the amount of traffic that can be obtained at each of the termini ; by ease of transit, secured by taking advantage of winds and ocean currents (specially applicable to sailing vessels) ; by directness, obtained by following an arc of a great circle in the case of steamers ; by the avoidance of handling goods through a change in the mode of transport (hence the importance of ship canals); and by the fact that trade is often obtained at several ports. The great circle course is the shortest path between any two points on the earth's surface, and the one the mariner naturally chooses wherever it is practicable, because time is important where valuable and perishable commodities and passengers are concerned. Consideration of the intervention of land, currents, ice, wind, unduly high latitudes, and other difficulties, often makes a modification of the shortest course desirable. In practice, ships usually sail on a series of lines, which, though straight on the chart, nearly represent the curves, so that the change of course is in jumps rather than continuous. "Steam Lanes" have been established, where there is much ocean traffic, and these minimize the risk of collision, for the outward and homeward bound traffic keep to different "lanes."

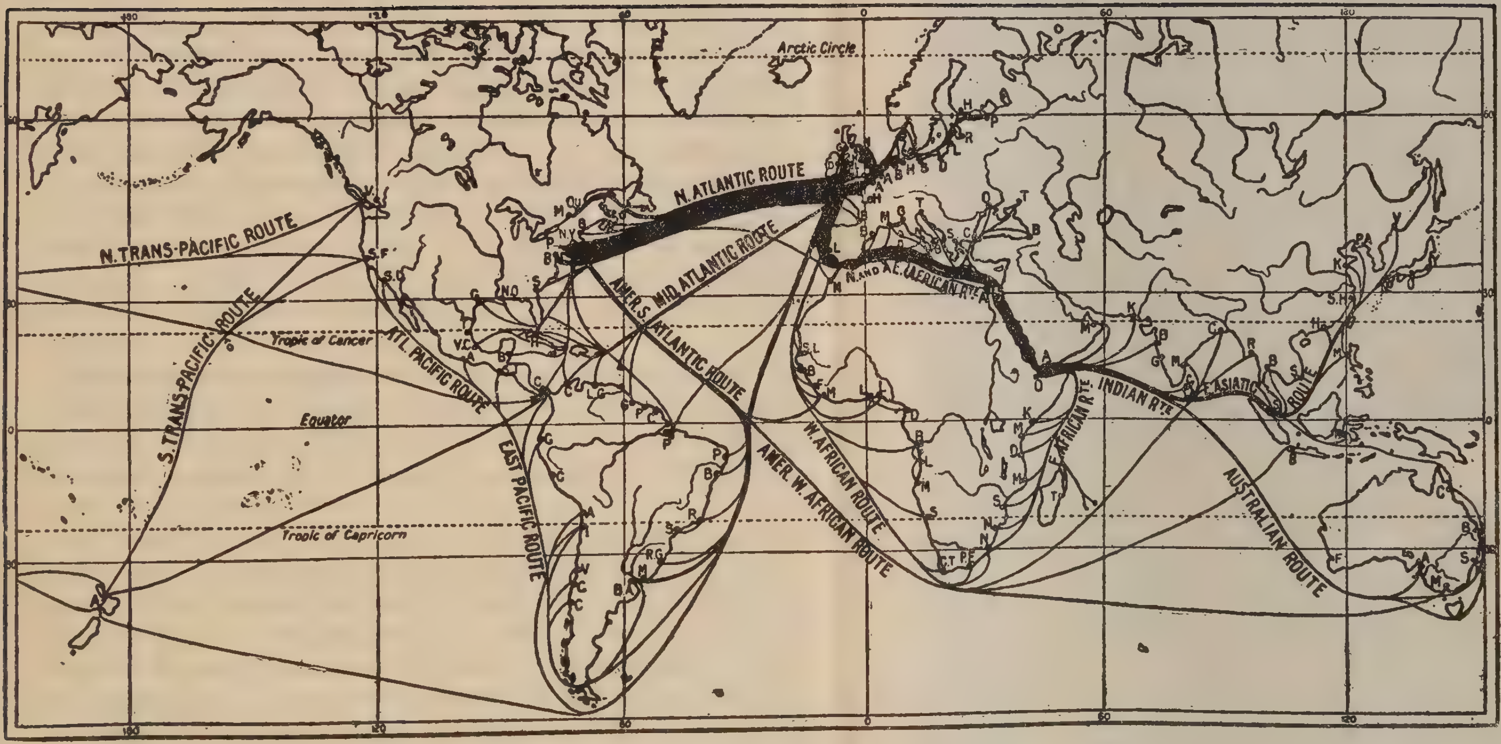
Liners and Tramps. Ocean transport is an important means of international trade, and makes possible the specialization of countries. The traffic is of two kinds: "line" traffic, consisting of vessels belonging to regular lines, which make regular voyages on definite routes at definite times; and charter traffic carried on by "tramps," which have no regular routes nor times of sailing, but go wherever cargo is to be had, and compete for cargoes on the open market. The tramp is practically a necessity, for many food products and raw materials are only available in large quantities at certain seasons of the year. Tramps carry the great bulk of the world's traffic, the heavy commodities—food and raw materials—without which the great manufacturing countries, as now constituted, could not exist. It is estimated that they carry 60 per cent of the world's commerce. Britain's commercial prosperity rests primarily on her well-protected fleet of tramps. A shipper, prepared to fill a whole ship, applies to a firm of ship-brokers, whose business it is to know where cargoes are to be had when the tramp has unloaded her cargo, and so needs economical employment. Liners handle the trade of high value, like manufactured goods and precious articles; perishable goods, such as fruits; commodities like the mails, which are required to be delivered speedily; and passengers. They serve the greatest number of shippers, the multitude who are unable to fill a ship with one consignment. Liners are very suitable for the carrying of the less bulky exports of manufacturing regions, and the imports of "new" and agricultural countries; while the tramps are well adapted to convey the more bulky imports of manufacturing regions, and the exports of "new" and agricultural countries. Lines of cargo steamers, with strong capitalistic backing, are now reducing the number of tramps and stabilizing the freight market. Tramps wander widely, and have the advantage of the element of speculation; but buyers tend to require smaller shipments, less cost of storage ashore, less capital tied up, and prompt deliveries. By the use of the wireless telegraph tramps are directed to cargo while still on the high seas, and thus the supply of vessels is adjusted to the demand for them. Like tramps, cargo liners are often fitted for special purposes, refrigerating machinery and insulated holds being used for the carriage of meat and tropical fruits, and oil-tanks to carry mineral oil in bulk. Sailing vessels, dependent on winds, currents, and tides, often compelled to make wide détours, and incapable of great speed and regularity of time, have declined greatly in recent years. They still carry the nitrate of soda, timber, and grain of Western America; but it would seem that their only hold on the future is in some irregular trade that cannot be organized.

Freight. Freight on ocean traffic is based on an allowance of 40 cu. ft. of hold space to each ton of cargo. Thus, light bulky commodities pay more on their weight than heavy ones. The nature of the goods and of the route also affect the charges. Certain manufactured goods are easily damaged; they, therefore, require careful treatment, and so the freight is raised. Explosives and acids, dangerous to the ship and the rest of the cargo, necessitate higher insurance rates, and this is also the case on dangerous routes; hence, higher charges are made. On frequented routes competition is keen, and consequently freights are lower. There are also discriminations in favour of certain traders, and to encourage particular kinds of traffic.

Size of Ship. The modern tendency is to increase the size of ships, because more economical management is then possible. Two ships of small capacity cost more to build, equip, and run than one ship of twice the capacity. The chief limits to growth are the size of the cargo likely to be obtained, the difficulty of controlling ships of vast size, and the harbour accommodation, although port authorities eventually provide harbour facilities. The introduction of mechanical propulsion has lessened the duration and uncertainty of voyages, and the size of crew needed for the working of a ship. The adoption of oil-fuel is increasing both the bunker and cargo capacity of ships, and tends to minimize the importance of coaling stations on all the great routes except the North Atlantic. It is on this latter route, which is provided with fuel at both the American and European termini, that the greatest improvements in shipping are to be seen. High-rated passenger service with cargo that can afford high rates of freight has resulted in the gigantic ocean greyhounds, floating palace towns of marvellous workmanship.

Ports. Ports correspond in sea communication almost exactly to the junctions on railways. Every seaport must contain a harbour, providing safe berths for ships, whether at anchor or moored to quays; deep water; and reasonable freedom from obstacles to navigation, such as reefs and shoals. An essential factor in the origin and growth of every commercial port is a productive, easily accessible, and populated hinterland. All ports must be situated conveniently for the internal commerce and industry of the regions they serve. They must be provided with proper wharf accommodation and equipment, and with railway facilities for inland communication; with victualling and coaling arrangements; and with slips, docks, and workshops for the repair of ships. Growth is almost always in direct relation to the size and productiveness of the hinterland of a port, though entrepôt trade or goods in transit assist ports conveniently placed for distribution to other markets. Land-locked inlets, deep and winding gulfs, and long estuaries make good harbours. Where a harbour is exposed in some direction, shelter from the prevailing winds must be provided. Near a delta, where the tides are of no account, ships can load and unload at wharves on which railways can be laid. Many harbours are, however, tidal; that is, they depend for depth of water on the rise of the tide, and are able to be entered or left only near high-water. In order to keep ships afloat continually docks with gates or locks are necessary; such are open for only a comparatively short period when the tide is high. Port charges are, naturally, higher than at ports near deltas. Many ports on estuaries, particularly old ports, originally placed far up the estuaries for defence and longer water-transport, have these tidal locks, and frequently their channels have had to be deepened to accommodate modern shipping. Sometimes outports, nearer to or actually on the sea, supplement the old ports, and, in some cases, take the major portion of the trade. The river or estuarine type of harbour is the most common. London, Liverpool, New York, and Hamburg are examples. Venice exhibits the lagoon type; Marseilles, the almost tideless type; and Dover and Madras, the artificial type. Twin-ports, ports with suburb outports, are exemplified in Bremen-Bremerhaven, London-Tilbury, and Rouen-Havre.

OCEAN TRADE ROUTES.—North Atlantic Routes. The most important ocean trade follows the North Atlantic route from British and continental ports to the United States and Canada. Its European focus may be said to lie in the English Channel, while New York Bay may be considered to be its main American focus. The traffic is the largest and most competitive; has the fastest, luxurious passenger liners, which are steadily approaching a speed of 30 knots and a size of over 50,000 tons; and provides the best service for freight and emigrants between the old progressive countries of Europe and the newly developed North American countries. Great circle routes take the ships well to the north, and cause vessels from the southern and Gulf ports of the United States to steam more or less parallel to the North American coast before turning eastward to join the main traffic. Closeness of the routes is striking, and "steam lanes" are, therefore, essential. There are few obstructions in mid-ocean, and the chief digressions from the great circle course are due to the fogs and ice of the Newfoundland banks, and to the shallowness of the banks off Cape Hatteras. From August to January, owing to the safer conditions, more northerly, and so shorter tracks are followed than during the rest of the year. The autumn route from Liverpool to New York is 3,080 miles, and the winter and spring route is 3,200 miles. Fuel is abundant on both sides (there are no mid-Atlantic coaling stations), and ports are numerous. The chief European termini are Liverpool, Glasgow, Bristol (Avonmouth), Southampton, London, Hamburg, Bremen, Amsterdam, Antwerp, and Havre; and the American termini are Montreal and Quebec (in the summer only), Halifax, St. John's, New York, Boston, Philadelphia, Portland (Maine), Baltimore, Newport



SHIPPING ROUTES OF THE WORLD

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News, Norfolk, Wilmington, Charleston, Savannah, Galveston, New Orleans, and Mobile. Traffic spreads out to the American ports, for decentralizing causes have reduced the pre-eminence of New York, though not the volume of its trade. Eastwards, the routes converge on the ports of north-west Europe, and to a less degree on Mediterranean ports. With the completion of the new National Hudson Bay Railway, Port Nelson will become an Arctic seaport for a few weeks in the year, and will relieve the grain traffic congestion on the western plains. The main westward movement is in passengers, emigrants, and manufactured goods ; the eastward trade is in grain, meat, ores, raw material (particularly cotton, tobacco, and timber), and manufactured goods of all sorts, but chiefly machinery. Trips in ballast or part cargo are common on the westward passage, and freight rates, therefore, tend to be low. Among the great steamship lines of the North Atlantic are the International Mercantile Marine, the Cunard, the Holland-American, and the Norddeutscher Lloyd.

The South African Trunk Route. Smaller ships (seldom more than 15,000 tons), but not inferior in design and construction to those of the North Atlantic, are engaged on all the other ocean routes. The mixed passenger and cargo liner is also more common, and the speed is usually about 15 knots.

The South African Trunk route sweeps boldly along the West African coast to Cape Town ; two streams of traffic unite at, or near, the Cape Verde Islands—one from the ports of Western Europe, and the other from the Atlantic and Gulf ports of the United States. Vessels in the East African trade stop at Port Elizabeth, East London, and Delagoa Bay ; and a few continue to Mombasa and Zanzibar. All freight steamers and most of the traffic from the United States and Europe use this route to Australia instead of the Suez route ; for, though European vessels would save about 1,000 miles by going through the Suez Canal, yet the canal tolls are so high that it becomes cheaper for freight vessels to take the longer Cape route. From the ports of the United States to Australia, the Suez Canal route is practically as long as the Cape route. On the route between South Africa and Australia, the more important steamship lines steam directly to Adelaide, Melbourne, and Sydney, while a few continue to Brisbane. They avoid the great circle track which, dipping to lat. 62° S., would bring them among the Antarctic icebergs and pack-ice, and follow a more northerly and longer course north of lat. 44° S. The less important lines call at Fremantle, and afterwards run either direct to Auckland, or call at Melbourne and Hobart. Vessels engaged in trade with India and the Far East, after calling at the South African ports and Mauritius, steam north-east to Colombo, and join the Asiatic trunk route. Coaling stations are found on all the ocean routes except the North Atlantic; and, in the old days, one of the great causes contributing to Britain's sea-power was the fact that she possessed all the most important coaling stations in the world. Now, the strategical aspect has changed. Coal is being worked nearly all over the world and supplies are readily obtained almost anywhere; and the oil-burning steamer or the motor-ship can carry in her tanks enough fuel to take her practically round the world. The increased price in fuel and the constant increase in competition make it more than ever necessary to study economy, and the fuelling stations retain their importance, but in an economic direction. Coal is suited to the tramp traffic. It requires the lower rates for carriage, and provides the tramp with outward ballast cargo. The hold space of the coal-burning liner is more valuable than that of the tramp, and her bunker space is, therefore, restricted; and she is compelled to refill her bunkers at convenient coaling stations on the route. South Africa is well supplied with bunkering stations, and Cardiff coal can be obtained at Madeira, the Canaries, St. Helena, and Ascension Island. These coaling stations determine, therefore, in part, the course of the steamers on the African route.

Traffic on the African route is not spectacular, and has less emigrant and passenger trade than the North Atlantic. The backbone of the shipping is the cargo trade. Textiles, machinery, and railway plant are exchanged for wool, metals, fruits, rubber, oils, beverages, cereals, diamonds, ostrich feathers, and hard timbers. The Union Castle, Peninsular and Oriental, Aberdeen, and Australian Commonwealth lines are among the most important shippers. From Southampton to Cape Town the voyage is 6,000 miles; from London to Hobart 12,000 miles; and from London to Wellington 13,200 miles.

The Gulf of Mexico and the Caribbean Sea. These have been aptly called the "American Mediterranean." There are several outlets to the Atlantic: the Florida Strait between Florida and Cuba; the Windward Passage between Cuba and Haiti-Santo Domingo; the Mona Passage between Haiti-Santo Domingo and Porto Rico; and the passages between Guadeloupe and Barbados. All of these outlets are utilized by vessels from the Atlantic ports of the United States and those of Europe, and the traffic is augmented by shipping bound to and from the Pacific viâ the Panama Canal and the Windward Passage. The following ports and centres on the Caribbean Sea are engaged in a brisk trade: Guadeloupe, Port of Spain, La Guayra, Colon, Port Limon, Cartagena, Greytown, St. Thomas, and Kingston. The Gulf ports include Havana, Vera Cruz, Tampico, Belize, Bluefields, Galveston, New Orleans, Mobile, and Pensacola. Fruit steamers ply from the ports of the Central American Republics to the Atlantic ports of the United States, and from Jamaica direct to Bristol, Liverpool, Manchester, and Glasgow. The trade is an exchange of sugar, cotton, tropical fruits, fine woods, cocoa, asphalt, and tobacco for manufactured goods of all kinds. Some steamship lines plying on this route are the Imperial Direct West India Mail Service Company, Elders and Fyffes, the Hamburg-American, the Manchester Liners, and the Royal Mail Steam Packet Company.

The River-Plate Route. From the ports both of eastern North America and of Europe important ocean trade is carried on with South America. The two streams of traffic feeding this route unite off Cape Roque. Vessels call at Rio de Janeiro and Santos for the coffee of Brazil, and at the Plate ports for grain and animal products. The terminus of much of the shipping is Buenos Aires (6,320 miles from Southampton), but many steamers pass through the Straits of Magellan to the southern Pacific ports of South America. Vessels engaged in the New Zealand trade, returning loaded to Europe, sometimes swell the traffic at the Straits of Magellan. Before the opening of the Panama Canal all the trade of Pacific South America with Europe, and most of that with western North America, had to pass round the south of South America. The trade is mainly in manufactured goods and coal in return for cereals, meat, ores, nitrates, wool, cocoa, coffee, tobacco, rubber, fruit, and timber. There is a good deal of outward passenger traffic, but the emigrant traffic is chiefly from the Mediterranean lands. Among steamship lines using this route are the Royal Mail Steam Packet Company, the Pacific Steam Navigation Company, and the Lamport and Holt.

The Mediterranean-Asiatic Route. Next to the North Atlantic route in volume of traffic is that viâ the Mediterranean and the Suez Canal to and from India, East Africa, Australia, and the Far East. This route is the creation of the Suez Canal, which was opened in 1869. It has caused the virtual abandonment of the Cape route by mail and passenger steamers, and the return of the Eastern trade to the Mediterranean route. From London to Calcutta viâ the Suez the voyage is shorter by 3,700 miles than viâ the Cape. The total length from Port Said to Port Ibrahim, by Suez, is 87 miles of which 66 are actual canal, the remainder being a dredged passage through Lake Menzaleh, Lake Timsah and the Bitter Lakes. The canal is at sea-level throughout ; is without locks ; and is open to the vessels of all nations. Its depth varies from 36 ft. to 39 ft. (maximum draught allowed 31 ft.), and two vessels can pass each other in almost any part of the canal. The main Suez route may be said to have double termini in the ports of the east of the United States and those of western Europe. At Gibraltar, the first coaling station, the two streams of traffic meet. Thence the direct route is viâ Malta to Port Said, the gateway between the western and eastern worlds. Many feeders of the route come from Barcelona, Marseilles, Genoa, Naples, Venice, Trieste, Algiers, Odessa, and Alexandria ; and mails and passengers (by the overland routes) are picked up at Marseilles, Naples, and Brindisi. From Port Said, where coal is shipped, the eastern traffic traverses the canal, and passes down the Red Sea to Aden, another coaling station. Here the route divides ; the main stream continuing to Colombo, but important branches making either for Bombay or the many East African ports. At Colombo, another important coaling station, vessels for Madras, Calcutta, and Burmah turn northwards into the Bay of Bengal. The main stream proceeds eastwards through the Straits of Malacca to Singapore, the chief entrepôt and coaling station of the Far East ; and on to Hong Kong, Shanghai, Kobe, and Yokohama ; but the Australian mail steamers turn south-eastward and enter the long stretch of 3,120 miles to Fremantle. From London to Sydney viâ Suez the distance is 12,500 miles ; to Yokohama 11,900 miles ; and to Calcutta 8,000 miles. Welsh coal comes into competition with

Indian and South African coal at Aden and Colombo, and at Singapore Japanese coal appears ; but practically the whole of the Mediterranean uses British coal, and British stations supply no other kind.

More lands and more peoples are served by the Mediterranean-Asiatic route than any other route. Through its many ports of call it reaches three-quarters of the total population of the globe. Along its great highway pass westwards the multitudinous food products, raw materials, and manufactures of temperate, subtropical, and tropical lands, produced by peoples of varying degrees of development ; and eastwards go the machinery, textiles, and varied products of the industrial activity of the West. Among the chief shipping lines using the Suez route are the Peninsular and Oriental, the Australian Commonwealth, the Orient, the British India, the Nippon Yusén Kaisha of Japan, and the Nederland Royal Mail.

Pacific Routes. The Pacific, once comparatively a waste of waters, is now becoming important in world commerce, owing to the awakening of the Asiatic East and the opening of the Panama Canal, which brought several trans-oceanic tracks into prominence. The most traversed of the two great routes across the Pacific is the modified great circle route crossing the North Pacific and connecting San Francisco, Portland, Vancouver, and Prince Rupert with Yokohama, Shanghai, Hong Kong, and Manila. Yokohama has a splendid commercial position on this route, and is a most important coaling station. A secondary route from San Francisco to Yokohama viâ the Hawaiian Islands is about 1,000 miles longer. The chief trade is in tea, silk goods, sugar, tobacco, manila hemp, carpets, china, straw plait, rice, and lacquer ware of eastern Asia for the food products, cottons, woollens, metal goods, machinery, and railway plant of North America. Some steamship lines using these routes are the Nippon Yusén Kaisha, the Peninsular and Oriental, and the Pacific Mail.

The other great ocean highway of the Pacific, now followed also, in part, by most of the fast traffic between Europe and New Zealand viâ Panama, is the one connecting the Pacific ports of North America with those of Australasia. The voyage from San Francisco to Auckland is viâ Tahiti (Society Islands) ; that from Vancouver to Sydney is viâ Honolulu and the Fiji Islands ; and that from San

Francisco to Sydney is also viâ Honolulu and the Fiji Islands. These routes provide quick mail and passenger services from Australasia to Europe, and are served by the lines of the Canadian Pacific, the Canadian-Australasian, and the New Zealand Shipping Company. Most of the little traffic between Australia and South America consists of eastward bound coal from New South Wales, usually conveyed in sailing ships. The South Pacific is deserted except between the forties and fifties of south latitude, where it is traversed by the east-bound traffic viâ Cape Horn for Europe, which consists of Australian wheat and wool, New Zealand mutton and hides, and nickel-ore from New Caledonia.

Panama Routes. The Panama high-level Canal, opened in the autumn of 1914, marked the completion of the most colossal engineering undertaking of all time. From deep water to deep water its length is 50 miles, of which only 15 miles are at sea-level. The Panama isthmus through which it is cut, runs from west to east, so that the Atlantic entry (Cristobal, port for Colon) is to the north, and slightly to the west, of the Pacific entry (Balboa for Panama). Seven miles from Cristobal vessels ascend the three Gatun locks to the summit level of 85 ft., and pass along the dredged channel in the artificial Gatun Lake. From Gatun Lake the canal passes through the Culebra Cut, and after continuing for 31½ miles at high-level descends by the Pedro Miguel and the two Miraflores locks to the Pacific stretch of 11 miles. The minimum depth of the canal is 41 ft., and the minimum width 300 ft. Water for the canal is obtained from the Chagres River, which is fed by the abundant tropical rainfall. The largest vessels afloat can use the canal, the passage, normally, occupying seven or eight hours. Its disadvantages are the liability to landslides in the cuttings, and its tropical position. The construction of the canal was undertaken by the Government of the United States largely for strategic reasons, but it has had the effect of making her a Pacific power, and giving her great advantages in South American, Far East, and Australian trade. Both Cristobal and Balboa are coal and oil bunkering stations.

To understand the effects of the Panama Canal on world trade routes it is necessary to realize that practically the whole of South America lies to the east of North America; that the only sea route previous to the opening of the canal between eastern and western

America was by Cape Horn or the Straits of Magellan ; and that the great manufacturing countries of the world, excepting Japan, lie on the Atlantic and its seas. The influence of the canal in readjusting regular lines, adding new ones, and in facilitating the passage of tramp steamers to and from Pacific and Atlantic ports, is great. The Pacific is now placed in closer relations with the manufacturing countries, and the adjustment greatly favours the United States. In general, ships in the Pacific, American, and European trade pass through the canal. The great saving in mileage is shown in the following table—

To.	From Liverpool.		From New York.	
	Magellan Route.	Panama Route.	Magellan Route.	Panama Route.
	Miles.	Miles.	Miles.	Miles.
Vancouver	14,570	8,647	14,160	6,089
San Francisco	13,770	7,847	13,135	5,262
Guayaquil	10,582	5,382	10,215	2,810
Valparaiso	8,747	7,207	8,380	4,633

Formerly all the trade of the Asiatic ports of the Pacific to and from European and American Atlantic ports passed either viâ Suez or viâ the Cape of Good Hope. The following table shows that for Asiatic ports east of Hong Kong the Panama route is an advantage to the Atlantic ports of North America, but the Suez route is better for European ports and even for American to the ports of the Indian Ocean—

To.	From Liverpool.		From New York.	
	Suez Route.	Panama Route.	Suez Route.	Panama Route.
	Miles.	Miles.	Miles.	Miles.
Yokohama	11,678	12,372	13,564	9,835
Hong Kong	9,785	13,957	11,655	11,744

The canal brings Australian ports nearer to the Atlantic ports of North America but not to European ports, and brings New Zealand much nearer to eastern North America and appreciably nearer to

Britain. The New Zealand mail boats now go viâ Panama in place of the Magellan route—

	From Liverpool.		From New York.	
To.	Suez Route.	Panama Route.	Suez Route.	Panama Route.
	Miles.	Miles.	Miles.	Miles.
Melbourne . .	11,654	12,966	13,083	10,392
Wellington . .	12,989	11,058	11,414 (Magellan Route.)	8,872

Other factors besides the shortening of distance determine whether the two great ship canals will be used, and which will be preferred to the other. Canal tolls may make a longer route preferable ; the provision of coaling stations, better in the case of the Suez route, may decide the route ; and the possibilities of obtaining cargo may be more favourable at certain times on one route than on the other. The Panama Canal is certain to prove a great factor in the development of British Columbia ; and will probably bring about a revival of the round-the-world trading voyages. Ships will sail eastward by Suez, cross the Pacific to America, and continue through the Panama Canal, saving time, and benefiting by the abundant supplies of American bunker coal.

The North Sea and English Channel Routes. The trade routes from Great Britain to the North Sea, Baltic, and English Channel ports of the continent are of prime importance, and the highways of much sea-borne commerce. The North-Sea trade may be divided into that of the mainland and that of Scandinavia. In Britain the eastern ports, especially, London, Harwich, Grimsby-Immingham, Hull, Newcastle-on-Tyne, West Hartlepool, and the ports of the Forth, carry on the trade. The chief European ports engaged are Dunkirk, Antwerp, Amsterdam, Rotterdam, Bremen, Hamburg, Oslo (Christiania), Bergen, and Drammen. To the North-Sea countries Britain exports coal, cotton and woollen goods, and machinery ; and imports from them dairy produce, colonial produce, timber, metals, beet-sugar, wine, glass, amber, dyes, toys, watches, ice, and fish. The Baltic ports are Copenhagen, the great commercial centre of the Baltic trade, Göteborg, Malmö, Norrköping, Stockholm, Helsingfors, Leningrad, Riga, Reval, Memel, Königsberg, Stettin, and Kiel. The chief British exports to the Baltic countries are woollen and cotton goods, machinery and coal; and Britain imports from them timber, wood-pulp, dairy produce, cereals, flax, hemp, and iron-ore. Navigation is impeded on the Baltic for three to five months in the winter owing to many of the harbours being ice-bound. An important passenger trade is carried on over the North Sea by vessels of the London and North-Eastern Railway, the Ellerman's Wilson line, and the United Steamship Company. Important routes are: Harwich to the Hook of Holland, Rotterdam, and Antwerp; Hull and Grimsby to North Sea and Baltic ports; London and Dover to Ostend; and Queenborough and Folkestone to Flushing.

The cross-routes of the English channel, served by the packet steamers of the Southern Railway, are: Dover to Calais; Folkestone to Boulogne; Southampton to Havre, St. Malo, Cherbourg, Guernsey, and Jersey; and Weymouth to Cherbourg and Guernsey. There is direct shipment from London to Havre or Rouen. The ports of South Wales and of the Tyne carry on an important trade in coal with the northern ports of France. Coal, cotton and woollen goods are exchanged for the dairy produce, vegetables, fruits, articles of fashion, and the silk and linen goods of France. The English Channel is one of the most important ocean ways of the world, for it is used by all the steamship lines of the North-Sea ports trading with all parts of the world, and also by the busy packet steamers plying between England and France.

Coastal Routes. The coasting trade of the great commercial countries, although less picturesque than long-distance trade, is of great moment, and is carried on not only by coasting steamers, but sometimes by the great world-lines.

Minor Ship Canals. THE MANCHESTER SHIP CANAL. By its completion in 1894, the Manchester Ship Canal has made Manchester a seaport for vessels up to 12,000 tons capacity. It runs from Eastham through Ellesmere Port, Runcorn, and Warrington to Manchester, and is 35½ miles in length. Its depth is 28 ft., and it has a minimum bottom width of 120 ft. There are five sets of locks, each lock being 600 ft. long. Steamship lines now connect

Manchester with all parts of the world, and the annual tonnage of toll-paying traffic is approximately 5,500,000.

THE KIEL CANAL. This canal runs across Holstein from Holtenau, near Kiel, to Brunsbüttel, near the mouth of the Elbe, a distance of about 61 miles. It is 144 ft. wide at the bottom and 36 ft. deep, and has four locks at each end. Primarily built for the needs of the German navy, it is now open to the vessels of all nations, and saves the long détour round Denmark for vessels bound from the Baltic to the North Sea.

THE TROLLHÄTTAN-GÖTA CANAL. This canal links the Kattegat with the Baltic viâ the great lakes of Sweden. It has sixty-four locks and rises from sea-level to 300 ft.

THE CORINTH CANAL. The Gulf of Corinth is connected with the Gulf of Aegina by the short Corinth Canal (four miles long), which has been cut through the Isthmus of Corinth. It shortens the voyage between the Ionian and Aegean seas, but is little used.

The World's Shipping. In number of sea-going vessels and total mercantile tonnage, Great Britain has long had the lead, and in spite of great losses during the War, and the growth of the shipping of the United States since 1914, she still easily leads. The following table gives the approximate merchant tonnage in millions of tons, of the principal ship-owning countries—

	June, 1914. Tons gross.	June, 1924. Tons gross.
Great Britain and Ireland	18·88	18·92
British Dominions	1·41	2·21
United States	1·84	11·82
Germany	5·10	2·86
Japan	1·64	3·66
France	1·92	3·19
Italy	1·43	2·68
Holland	1·47	2·53
Norway	1·92	2·33

A remarkable contrast is shown by the tonnage of steamers and sailing ships in 1890 and 1924 respectively. In 1890 the gross tonnage of steamers amounted to 13,000,000 tons, and the net tonnage of sailing vessels to over 9,000,000 tons. In 1924 the steam and motor tonnage had increased by over 48,500,000 tons, while the sailing tonnage had decreased by over 7,300,000 tons gross. Only about 5 per cent of the world's ocean tonnage now consists of sailing vessels, and most of these are owned by Norway. Over 17,000,000 gross tons of the world's steamers are now fitted for burning oil fuel. One of the greatest war-time achievements of the United States was the construction of one of the largest mercantile marines in the world in a period of two years. She is finding now, however, that her capital accumulations yield the best returns when invested in home industries, and her shipping, therefore, does not tend to increase. America lacks the goodwill established in shipping by the British, and the sea-prestige, the evolutionary growth of centuries.

Posts, Telegraphs, and Languages. Postal and telegraphic facilities have developed to meet the demands of modern trade, and have done much in bringing into close relations lands widely apart in distance. The introduction of the penny post in the United Kingdom in 1840, the formation of the Universal Postal Union in 1874, and the institution of the Imperial Penny Postage in 1899, were landmarks in postal communication. The Great War caused many postal facilities to be withdrawn and postage rates to be increased, but, doubtless, pre-War conditions will eventually be established. All countries in the world now belong to the Universal Postal Union, and only in the remoter parts of the Old-World deserts and Siberia is there no postal communication. Many countries pay subsidies to steamship and airship lines to convey their mails regularly and to fixed schedule.

The practical use of the electric telegraph dates only from 1846. By its aid the traffic on the railways is controlled, and price fluctuations are lessened on the world's markets. The first message by submarine cable was sent from England to France in 1851. Fifteen years later, the first workable Atlantic cable was laid by the "Great Eastern" between Valentia and Newfoundland. Since then cables have multiplied to such an extent that practically all lands are linked by telegraph. An interesting British world cable and telegraph route is that which starts at Valentia Island and proceeds to Trinity Bay, Newfoundland, and across the island to Placentia Bay. It then goes viâ Sydney (Cape Breton Island) to Halifax, crosses Canada to Vancouver, from whence the cable runs viâ

Fanning Island, the Fiji Islands, and Norfolk Island, to Auckland, Wellington, and Sydney. From Sydney there is overland connection with Melbourne and Adelaide, whence there is again cable connection with Albany and Perth. The route across the Indian Ocean is viâ Cocos, Colombo, Madras, Bombay, and Aden, and the circuit is completed through Suez, Port Said, Malta, Gibraltar, and London. For commercial purposes the chief cables and telegraphs follow the same directions as the main-trade routes.

Wireless telegraphy has made great strides in recent years, and by its cheapness and safety it seems destined to displace largely cable communications. It was only in 1902 that wireless communication was established across the Atlantic, and now there are high-power wireless stations throughout the world. In 1920, the British Government adopted a scheme for the establishment of an Imperial wireless system, which will link up the empire by stages of about 2,000 miles each. Stations of high-power in Cornwall, Egypt, India, Malaya, Australia, Zanzibar, South Africa, and Newfoundland will be linked up with each other and with stations of less power in the smaller colonies.

The telephone is used mainly for short distance communication, although in the United States a direct line for 1,542 miles is in regular use between Boston and Omaha. Most extensive use is made of it in Scandinavia and the United States. In Great Britain it is less widespread.

English is the most widely spoken language of commerce, owing to the extent of the Empire and the predominance of British shipping. In tropical America and South America (except Brazil where Portuguese is the language) Spanish is spoken. Two corrupt forms of the English language, known as " pijin " English, and " bêche-de-mer " English have a wide vogue in the ports of the Far East and the islands of the south-western Pacific. Arabic, corrupt or pure, is a necessary language in the Mohammedan lands. Chinese is the prevailing language of trade, not only in China, but on all the coasts of Indo-China; and the Malay tongue predominates in the Eastern Archipelago. French and German are of relatively little use in trade outside Europe, and Russian is confined to Russian territory.

Air Transport. Transit by air is the latest development in transport. It is yet in its infancy, but may eventually justify the vision of Tennyson, when he—

> "Saw the heavens fill with commerce, argosies of magic sails,
> Pilots of the purple twilight, dropping down with costly bales."

There are two types of air-vessels: the airship, which relies on the use of a large volume of gas to give it buoyancy and so is lighter than air; and the aeroplane, which has no gas container, and is heavier than air. Progress so far has been made chiefly in the use of the aeroplane. Its sphere lies in the carriage of passengers, mails, and valuable goods which need either safe or rapid transit. Frequent aeroplane services leave Croydon for Paris, Brussels, the Hague, Cologne, Amsterdam, and Berlin. An air-route is in operation between Paris, Strasbourg, Prague, and Warsaw, and another joins Toulouse, Barcelona, Alicante, Malaga, Rabat, and Casablanca (Morocco). There are also air-services between Cairo and Baghdad, and in various parts of the United States. The air-route from London to Australia, viâ Lyons, Rome, Cairo, Baghdad, Calcutta, and Singapore, was traversed by Captain Ross Smith in 1919; and the Atlantic has been crossed by both aeroplane and airship. For the long-distance routes (stages of at least 1,000 miles at a time) the chief hope lies in the airship. Probabilities of the future are air-routes to connect the various parts of the Empire, which will have key-points in Egypt, Cape Town, Malta, Bombay, Jamaica, Ottawa, Perth, and Sydney. Whatever may be the future development in air transport, it seems unlikely that the airship and the aeroplane will be able to compete with railways and ships for the carriage of bulky goods; but for passenger, mail, and precious goods their future is hopeful, and they will be specially helpful in time of war and as another link in uniting distant countries. It is safe to say that, owing to the position of the various parts of the British Empire, Britain is bound to be the biggest commercial air Power, and will be admirably situated in case of war. Egypt will be the junction of the Old-World routes; Jamaica will be the hub of the New World; whilst Australia and New Zealand are as well-fitted to control the Southern Hemisphere as is England to control the routes of the north. A fitting conclusion to this chapter may be given in Kipling's statement: "If you can tie up a nation's transport you can take her off your books."

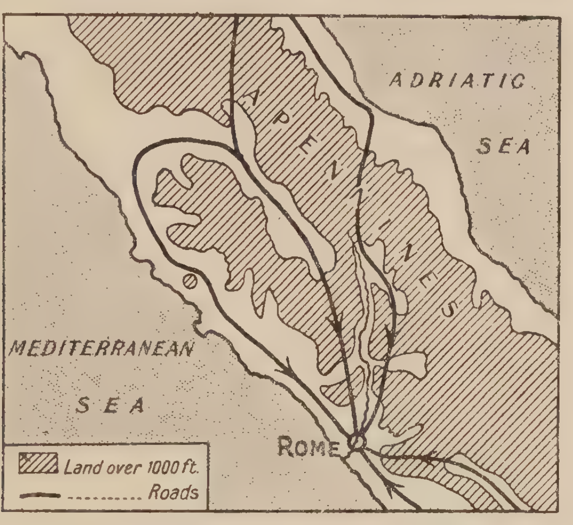
CHAPTER XI

Influences which Determine the Sites of Great Commercial Towns and Ports

> "Cities and Thrones and Powers
> Stand in Time's eye,
> Almost as long as flowers,
> Which daily die.
> But as new buds put forth
> To glad new men,
> Out of the spent and unconsidered earth
> The cities rise again."—*Rudyard Kipling.*

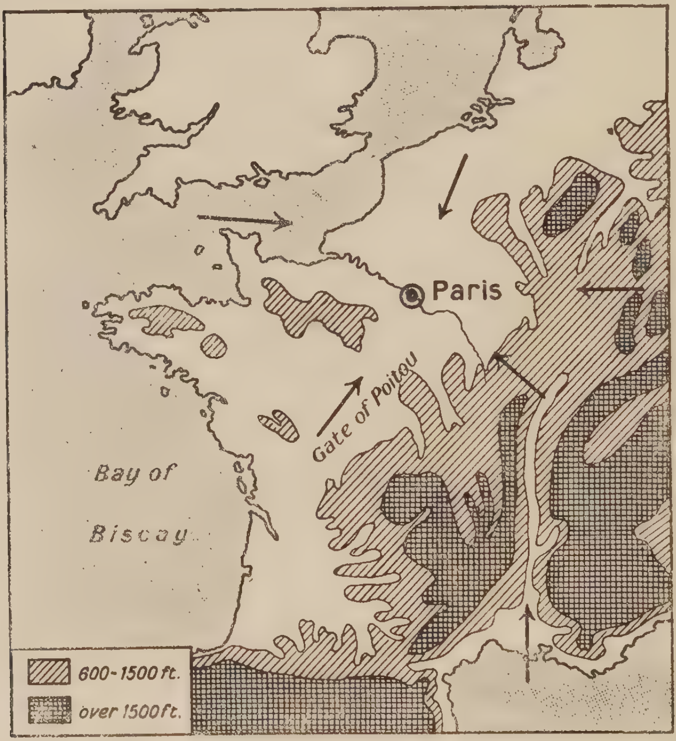
Towns are evolving social organisms, " places in space, and dramas in time." Their origin and growth, whether they are small or large, villages or " con-urbations " (great cities with neighbouring towns forming one huge mass), are the direct consequences of the division of labour, the outcome of the operations of geographic controls, both past and present, and the result of man's demanding food, clothing, shelter, wealth, health, defence, pleasure, and religion from his environment.

THE BEGINNINGS OF SETTLEMENTS.—Modern peoples first appear upon the stage of history in the rôle of wanderers to whom the soil had little appeal, and true towns arose only when the soil eventually gripped these nomads, and gave them fixed homes and horizons. Their earliest towns came into existence at places possessing obvious agricultural, military, and trading advantages. Athens, controlling the wet ways of Greece, had hill and sea-defence ; Rome, on the banks of the then navigable Tiber, on seven low hills in the heart of a fertile plain, was situated some 15 miles from the open Mediterranean, strongly commanding the landways of Italy and easily accessible by water ; Edinburgh, on a volcanic plug in the rich Midland valley of Scotland, needed defence only on one side ; Ely, on a gravel island, was protected by the surrounding fens ; and Venice by its lagoons. River sites were frequently chosen on account of the facilities for communication and the natural barriers which the rivers presented to invaders. All the great rivers of Europe were studded with lines of strongholds, either upon their banks or close by. Paris, on the Ile de la Cité, in the Seine, was a strong fortress of the Gauls; and Cologne, Bonn, Avignon, and Arles were strong castle-towns on the sharp rocks of the Rhine and Rhone. Early invasions of England came chiefly from the south-east coast, and so protection was sought and largely secured by the establishment of such fortress towns as London, Winchester, and Rochester. In times of peace and security, towns were often built for trade and barter on the most accessible and healthy sites, but frequently they had to be fortified. Religion and religious foundations had great town-creating powers. The rise and growth of Mecca, Lhassa and Benares must be associated with religion and the pilgrimages. York and Reading grew up side by side with great religious houses; and the places of entry of peoples such as Canterbury, St. Andrew's, and St. David's became the holy cities of their respective lands.



SKETCH TO SHOW THE SITE OF ROME.

Industrial and Commercial Centres. Most modern cities have both commerce and industry, but exist mainly either as commercial or industrial centres. Thus, Birmingham, Pittsburg, and Lyons are industrial centres, while Liverpool, New York, and Hamburg are commercial cities. Some advantage in transportation is the fundamental cause of the location of most towns. Roads converge on London and Manchester; rivers meet at Lyons and Hankow; railways centre on Winnipeg and Chicago; and at Montreal and Boston a change in the method of transport is essential. Food, formerly a question of agriculture, is now, at least for complex societies, chiefly one of transport, and many of the world's great ports and towns have originated and grown through the development of transport facilities. Whatever be the origins of towns, nothing has more influence on their destinies than the history of routes. The favourable sites for towns in river basins are where a ford occurs (Oxford, Utrecht); where



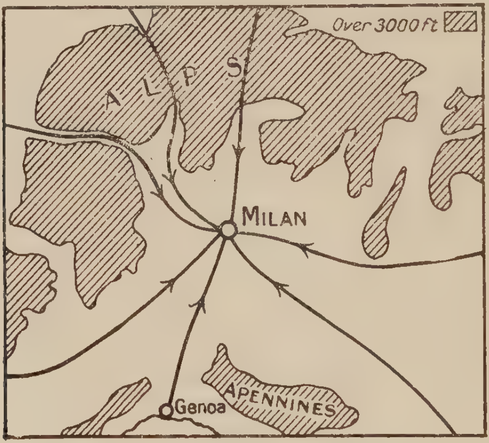
Sketch to show the Site of Paris.

the river can be bridged nearest its mouth (London, Buda Pesth); at the head of river navigation (Rouen, Montreal); at a confluence (Allahabad, Coblentz); at the highest point to which the tide rises (Teddington); at a bend (Magdeburg, Toledo); at a "water-gap" (Leeds, Lewes); at the head of ocean navigation (New York, Havre); and where the river enters or leaves a lake (Astrakhan, Geneva). Health and pleasure resorts, many of them young, are illustrated by the Riviera towns, and Buxton, Spa, Marienbad, and Bath. They owe their modern growth to the creation of smoky manufacturing centres in the nineteenth century.

Personal Factors. One of the most powerful agents in the birth and growth of towns is the personal energy of enterprising and persevering men, who by superior education, skill, scientific knowledge or foresight have founded towns in situations, which are not always geographically favourable. The genius of the Wedgwoods and the brilliancy of the artist, Flaxman, caused the growth of the Staffordshire pottery towns. To the foresight of Peter the Great was due the birth of Leningrad; and the skill and knowledge of Sir Titus Salt caused the birth of Saltaire. In 1906, the site of Gary, Indiana's future great lake port, was occupied by shifting sand dunes; to-day, through the efforts of the Steel Corporation of the United States, it is a steel manufacturing town and port with a population of 57,000. Washington, Ottawa, and Canberra, selected as capitals of federations of states, owe their birth to politicians and their growth to the work which administration entails. Historical and political movements have more powerfully influenced the development of capitals than the physical conditions under which they have been established.

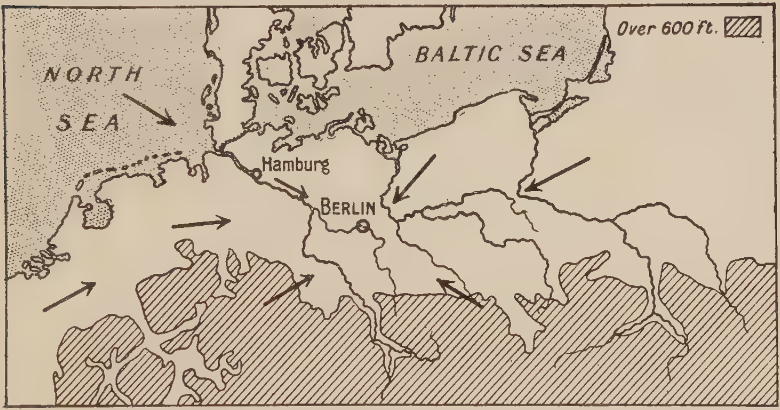
The Attraction of Natural Wealth. Natural wealth, especially of the useful metals and minerals, always attracts people to the favoured districts. Its power is shown by the rise of the early centres of Salisbury and Norwich; the mushroom growth of the modern gold towns, Dawson City and Coolgardie; and the birth of many towns on the British coal-fields. Even when climatic and other conditions are remarkably adverse, wealth in the concentrated form of precious metals and minerals brings masses of men together as in the tundras of the Yukon, the dreary veldt around Johannesburg, and the dry, hot deserts of Western Australia. Exhaustion of supply causes these purely mining towns to decline; thus, Dawson City had a population of 25,000 in 1896, while, to-day, it has dwindled to less than 2,000.

Strategic Advantages. To the commercial and strategic advantages of a position on a strait are obviously due the origins of Constantinople, Gibraltar, Aden, and Messina; and their situations along natural roads and river valleys by which armies can cross the frontiers explains the existence of such towns as Belfort, the guardian of the valley between the Vosges and Jura, and Verdun, the guardian of the valley of the Meuse. Routes converging on gaps through a ridge of hills, or between highlands and the sea, cause the rise of either trading towns like Lincoln, Turin and Milan, or military stations like Peshawar.



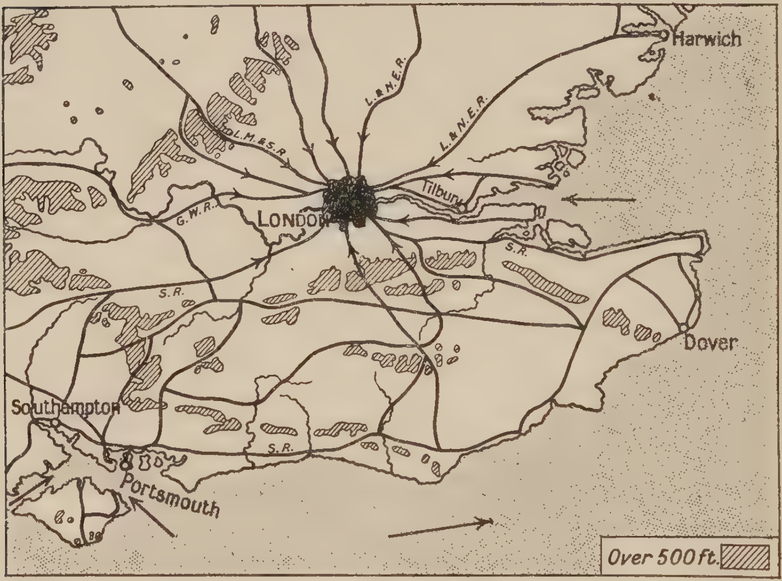
Sketch to show the Site of Milan.

Convergence of Natural Regions. Where two regions producing different natural products converge, towns tend to arise, for here the inhabitants of the two regions are likely to meet for the exchange of goods; thus, Milan at the foot of the Alps, and yet in the plain, is the market for the products of the plains and mountains; and the old English towns of Chester, Shrewsbury, and Ludlow still exchange the products of hill and plain, of stock-raisers and corn-growers. Water-power and its conversion into electricity have caused and aided the growth of the "fall" towns—Columbia, Richmond, Trenton—St. Paul, Buffalo, and Minneapolis in the United States, and of Kinlochleven in Scotland. Towns are found where routes intersect in the centres of plains (Moscow, Berlin); and on the edges of deserts where caravan routes converge (Damascus, Timbuctu). In the scarplands of England, a common site for a town is where water can be secured as at the foot of the chalk escarpment, or where sandstone rests upon clay. Examples are Guildford, Maidstone and Redhill. The world's great cities are situated at the oceanic termini (the ocean ports) and "factory ends" (towns, the centres of manufacturing areas as Manchester) of the great trade routes—the most convenient points for the receipt of goods in bulk and for their eventual distribution. Trade centres spring up with the development of every new manufacture and the establishment of every new colony. Because of city growth and congestion, man's home space, work space, and sustenance space have each become distinct, and more and more widely separated.



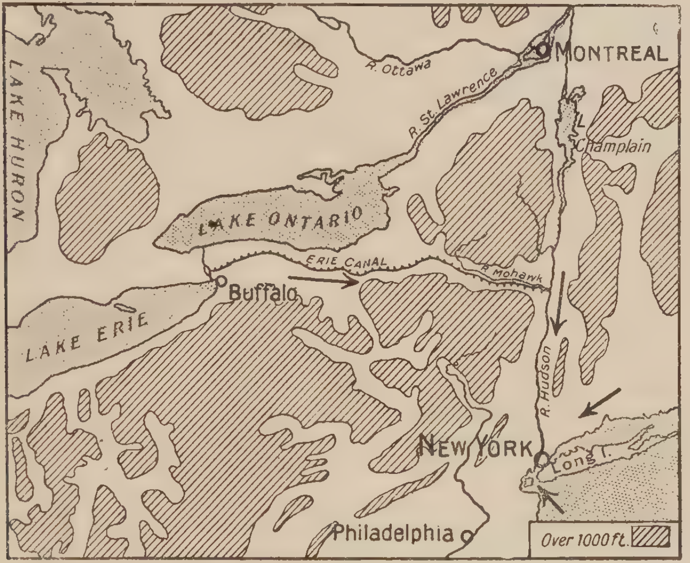
SKETCH TO SHOW THE SITE OF BERLIN.

Combined Causes of Growth. It must be noted that there is generally a combination of causes in the origin and growth of towns, and that in the struggle for existence towns tend to decline when their geographic advantages diminish with advancing years, unless they are artificially aided, and thus survive by geographical inertia, as Bristol and Swansea; or there are resident in them workers who at once appreciate the practicability or otherwise of ideas, and thus make it possible for labour and capital to be rapidly transferred into allied branches of industry when the staple trade declines, as at Coventry. Ease of obtaining raw materials for manufacture, excellent water-power in the early stages and afterwards steam-power, a plentiful water-supply, favourable climatic factors, good transport facilities, and inherited skill of the workers, account for the prominence of the Lancashire cotton towns. London had the initial advantages of an alluvial site not liable to flooding; of a bed of gravel supplying ample quantities of good water; a position at the head of navigation which could be easily bridged; and high tides which considerably helped navigation. The valley of the Thames with its numerous branching valleys, gives London access to the heart of the country; and the position of London in the centre of the world's land-mass facing the great populations of western Europe, and with easy access across the North Sea to the mouths of



Sketch to show the Site of London.

the Scheldt, Rhine, and Elbe, has made it a world-centre of routes; while the Thames estuary is capable at the same time of admitting large ships, and of affording protection from attack by sea. New York, the second city of the world, is favoured with a deep and sheltered harbour; is favourably situated for trade with western Europe; is the nearest oceanic port of the United States to the region of the Great Lakes; commands much raw material; and has easy access inland by the Hudson and Mohawk valleys. Paris, easy to defend in its youth, stands on the navigable Seine in the middle of the northern plain of France, over which must pass all the overland transit trade viâ Marseilles between the Mediterranean Sea on the one side and Britain and America on the other. It commands river valleys which are avenues to Holland, Belgium, Germany, Switzerland, Italy, and south-east France, and so controls all the important roads and railways. Constantinople, situated where Europe and Asia are separated by a channel never more than five miles, and sometimes less than half a mile across, at a point commanding the great waterway between the Mediterranean



SKETCH TO SHOW THE SITE OF NEW YORK.

and the Black Sea, has had immense scope for commercial and political action in rich and varied regions of the world. It is a natural citadel, always difficult to approach or to invest, and can, under ideal conditions, claim as its appropriate sphere of influence, the vast domain extending from the Adriatic to the Persian Gulf, and from the Danube to the eastern Mediterranean.

The Industrial Revolution. The great inventions and international discoveries of the eighteenth century entirely changed the face of all the countries of Europe, but more particularly that of England. In the seventeenth century, the large towns of England were to be found in the agricultural and pastoral area south-east of a line connecting the Wash with Bristol; by 1750, a movement northwards had set in; and the Industrial Revolution gradually established ugly industrial towns on the coal and iron fields of Britain, so that now the bulk of the population of Britain is to be found in the large towns north and west of the Wash-Bristol line. Few of these towns inherited the civic traditions of the mediaeval boroughs, a loss their citizens deplore and seek to modify. The new means of transportation, the railroad, has created important trade centres, where under older conditions they could not have been born. Crewe, Swindon, Winnipeg, and Le Creuzot owe their very existence to railways; and the old towns of Rugby, York, Carlisle, Namur, Prague, and Warsaw have developed into modern nuclei of railway traffic.

Seaports. The evolution of seaports provides examples of the growth of some towns and the decline of others. All embayed coasts, except in polar and other regions inimical to all historical development, show in the evolution of their ports to the highest type a gradual elimination of minor ports and the concentration of maritime activities in a few large ports favoured with deep and capacious harbours, productive hinterlands (trading lands behind the seaports), and excellent river, canal, and railroad communications with the interior. Early stages in commerce were marked by a multiplicity of ports, the activities of which were similar in amount and kind. The merchant marine of England in the fourteenth century was distributed among a large group of small but important ports on the English Channel, favourably located for the French and Flemish trade, and in an eastern group from Hull to London, engaged in Flemish, Norwegian, and Baltic trade. Overpowering competition has brought about their decline, and led to the predominance of London, Hull, and Southampton. Modern vessels tend to increase in size and tonnage, and so have arisen new port-problems. The old Hanseatic League ports were located on rivers six to sixty miles from the open sea, always on the inner edge of the coastal belt. To-day, in the majority of cases, the river port declines, and the inner edge as marked by ports moves seaward into deeper waters, and thus the coastal zone narrows. Alexandria has displaced Cairo ; Seville has declined in favour of Cadiz ; Hull dwarfs Goole ; Pauillac is supplanting Bordeaux ; and St. Nazaire is eclipsing Nantes. It is possible, however, by the creation of secondary ports for the largest vessels on or near the outer edge, and by dredging and otherwise deepening the waterway to the inner harbour, to retain the extent of the coastal zone. Thus, the twin-ports of London-Tilbury, Bristol-Avonmouth, Rouen-Havre, Hamburg-Cuxhaven, and Bremen-Bremerhaven keep the zone intact, and the deepening of the Clyde enables the largest vessels to reach Glasgow. It is a striking fact that the sites of the greater number of the gates of commerce are upon, or close to, the estuaries of navigable rivers, and that eight towns each having more than a million inhabitants, are situated on good harbours reached by large vessels, viz. : London, Leningrad, Glasgow, New York, Philadelphia, Chicago, Canton, and Tokio. International bargain centres, transaction centres for "futures," world-banking centres, and world entrepôts, are to be found at such ports as London, New York, and Chicago, all of which are protected by powerful governments and ideally placed for intercourse. All great ports owe a large share of their growth to industrial development, the ease of obtaining raw materials and the existence of assured markets giving them the necessary advantages. New York is the first city in America in the value of its manufactures.

Modern Tendencies. The more extended the division of labour becomes the larger and more numerous will the towns become ; but man needs to develop them into healthy, artistic, and soul-satisfying homes, seizing on and utilizing to the utmost all the elements of their natural situations. Modern man has found that only by means of improved transport facilities and the aid of sanitation is he able to live in such great masses as are found in the "con-urbations" of his creation. He cannot as yet see the limits to their growth, but their ugliness and vast extent have forced him to improve his surroundings by town-planning movements and the formation of garden cities, which help him to restore the healthy balance of nerve and muscle. Primitive man was for long a dweller on the open moorlands above the limits of dense forest-growth, entering the tree-clad valleys only as hunter or traveller; but, gradually, a valley-ward migration set in which has gone on almost to the present day, and has transferred the overwhelming majority of mankind and practically all the important trade centres to the near neighbourhood of streams. Recently, a tendency to move back to the higher ground to healthier surroundings and a closer touch with nature has been evident, though there is no indication of any attempt to go above the tree line. Modern engineering, especially in regard to water supply and means of communication, makes it possible to build towns, which have all the convenience of civilization and are within easy reach of the work-places in the valleys, on the higher, drier, healthier sites above the valley bottoms. In England the garden suburbs and cities, such as Hampstead and Letchworth, are on relatively high ground; many outer suburbs of London are on the heathlands and lower slopes of the chalk heights; Bournemouth has arisen on the sandy heaths above its cliffs; and many of the population of industrial Lancashire and Yorkshire reside on the lower slopes of the Pennines. It would seem, however, that much industrial and commercial work will always be in the valleys, and man must seek more and more the aid of nature and of art in the future development of his towns.

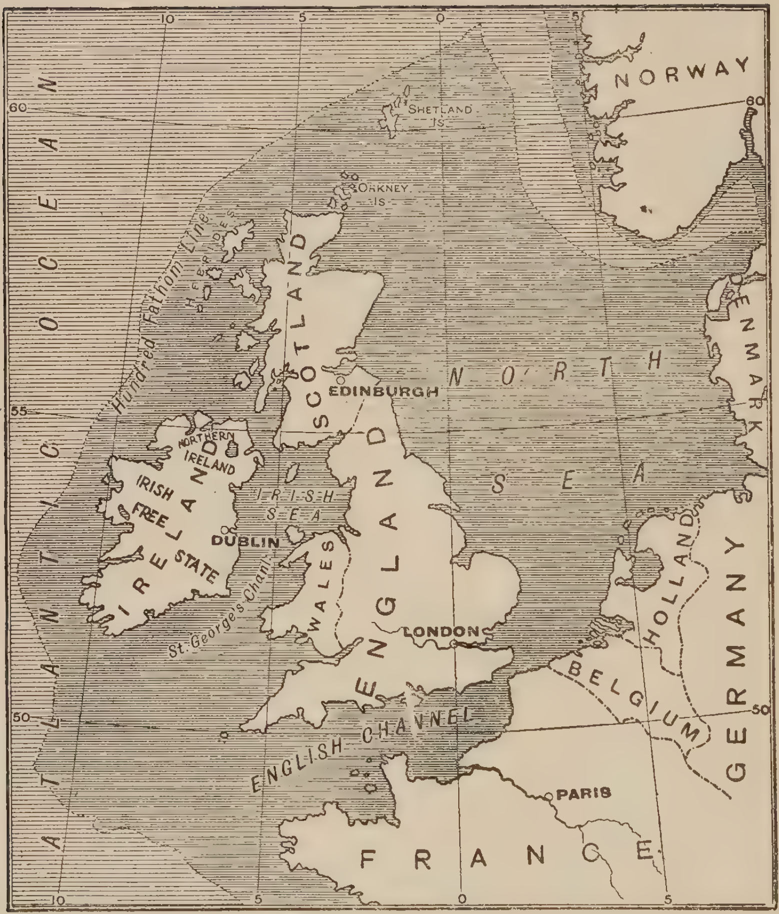
CHAPTER XII

THE BRITISH ISLES (GENERAL PHYSICAL CONDITIONS)

"Back to England as to a common fountain-head flow the might, the fullness, and the wealth of her thousandfold relations with the world."—*Ritter.*

(*a*) **POSITION.**—The British Isles, an archipelago of some 5,000 islands, lying between the fiftieth and sixtieth parallels of north latitude, and comprising an area of approximately 121,000 square miles, are really the higher parts of the partially submerged north-western portion of Europe. Knee-deep they lie on the continental shelf, mathematically, in the centre of the world's land mass; climatically, in a temperate area almost ideal for initiative and energy; commercially, on the edge of the North Atlantic, the busiest of oceans; and, nodally, the objective of all the Eurasian transcontinental railways north of the Alpine-Himalaya barrier, and of the Great-Circle routes linking the dense populations of eastern North America and north-western Europe. Their history is a continuous evolution, a progressive adjustment to an ever-widening environment. In the beginning they were on the outer rim of civilization; to-day, they are in the centre of the most highly-civilized states. Insulated but not isolated by the Narrow Seas, the Homeland of the British has proved impregnable when valiantly held; yet has allowed the peaceful penetration of men and ideas, and has given to her sons independence, love of adventure, rare bodily vigour, strength of will, calmness in deliberation, and boldness in action—factors of vital importance in industry, commerce, and warfare.

The Continental Shelf. Much of the Continental Shelf, whose western edge lies 100 miles west of Ireland, is near the surface. The greater portion of the North Sea on the east, the English Channel on the south, and the Irish Sea on the west, have an average depth of less than 50 fathoms. To the shallow seas Britain is greatly indebted for her freedom from icy oceanic currents; the mildness of her climate; the tides and currents which shape her coasts; her comparative security from invasion; the motive power



British Isles with Neighbouring Parts of the Continent.

for her shipping; and the wealth, position, and season of her fisheries. Tides, generated in deep oceanic waters by lunar and solar forces, are limited in their height in the open ocean, the rise and fall away from continental shallows being only 3 or 4 ft. Approaching the shores of Britain, however, the oceanic tidal wave strikes the edge of the submarine platform, passes suddenly into shallow water, and is sharply checked. Its speed is reduced, and the crest, less impeded by friction than the trough, tends to overtake the preceding trough, with the result that the amplitude or vertical height of the wave is increased; its length from trough to trough is diminished; and the rise and fall become many times greater than on the abysmal ocean. Where, as on the British shallows, the depth of the sea is comparable with the altitude of the tide, it is clear that to allow of the rise of the surface, large bodies of water must be drawn on to the shelf. True tidal currents—bodily transference of water from one part of the sea to another—thus occur in the British seas, and these are of great utility in moving shipping and clearing the estuaries of silt. Striking the south-west coasts the tidal wave splits into three portions, one penetrating the St. George's Channel, another the English Channel, whilst the third follows the Atlantic border, sending a branch tide through the North Channel which meets the St. George's, thus enabling large ships to cross the Mersey bar on the flood tide. Each of the three main waves subdivides when it meets an island; Southampton thus receives four tides a day instead of two, the ebb never being complete, for just as the Solent tide is ebbing, the Spithead tide enters, and vessels can enter the harbour at any state of the tide. Exceptionally high tides (18 ft.) occur in the Thames estuary where the northern wave, after passing through Pentland Firth, turns southward, and arrives at the mouth of the Thames just as a wave from the English Channel reaches the same region. Twice a day the tides convert the lower reaches of British rivers into arms of the sea. Estuaries, like those of the Severn and Trent, presenting a gradually narrowing front, concentrate the tidal energy, producing a crest-fronted wave of great amplitude (40 to 60 ft. at Chepstow) known on the Severn as the "bore," and on the Trent as the "aegre." Navigation is, thereby, made difficult. The bottle-shaped estuary of the Mersey exhibits the reverse conditions. Strong currents flowing through the narrow entry convey the large quantity of water needed to fill the large basin beyond, and in their forceful passage scour a channel between Liverpool and Birkenhead, keeping it relatively deep, and lessening the amount of dredging which would otherwise be necessary.

The western and northern coasts, wild, hard, and rugged, show physically and historically, Scandinavian origin and influence. They contain many sea-lochs, which form splendid natural harbours, but plateau hinterlands have prevented development, and seaports of world importance have arisen only on the estuaries of the Clyde, Mersey, and Severn. Lowlands open to the North Sea and the English Channel, and close physical and historical connection exists between them and the neighbouring continental lands. French and Latin influences are strong where Southampton Water faces the Seine estuary, and the white cliffs of Dover confront those of Calais. In the east the estuaries of the Thames, Wash, Humber, Forth, and Tay opening to those of the Scheldt, Rhine, Weser, and Elbe provided easy waterways for Teutonic influence. Thus, Nordic, Alpine, and Mediterranean culture have all contributed in the composition of the British race.

(*b*) **BUILD.**—In structure and relief the British Isles epitomize the geology of the world. From a belt of hard old rock in the north-west, carved picturesquely by glaciation and Atlantic exposure, the Homeland slopes to an expanse of soft "young" rocks in the south and east, which disappear under the shallow seas, exhibiting great variety without undue complexity, and varied scenery and resources under conditions very favourable to human activity. A remarkable contrast exists between the two regions lying respectively north and west and south and east of a line drawn from the Exe to the Tees. In the former lie the true mountainous regions of old formations, the most backward before the development of coal, now the bases of Britain's industry and commerce; and the latter is an extensive lowland, crossed by low scarped hills composed of "young" rocks, running usually in bands in a N.E.-S.W. direction, a region largely agricultural and less strenuous in outlook than the industrial north. Fertility of the soil increases with ease of access to Europe, and richness in mineral wealth with ease of access to the Atlantic.

Relief Divisions. Scotland has three clearly marked divisions:

the Scottish Highlands, a dissected plateau containing Ben Nevis (4,406 ft.), the highest mountain in the British Isles, lying north of the Highland line from Stonehaven to Kilcreggan; the Midland Rift Valley, a lowland crossed by hills of igneous rocks; and the Southern Uplands of wide, rounded moorlands, separated by V-shaped valleys. The Pennine plateau of England is flanked by plains, but is attached by Shap Fell to the picturesque Cumbrian Group in the north-west. In the south-west the Cornwall and Devon Highlands lie close to the west coast, while central and south-eastern England display alternate belts of plain and low ridge, of varied "young" formations—lias, limestone, and chalk. Wales is essentially a dissected plateau, difficult of access, an environment favourable to independence and the preservation of a native language and customs. The general form of the surface of Ireland resembles a shallow basin, the highlands being grouped mainly along the coasts. Much of the centre is covered with a rough sheet of barren and impervious clay, dotted with hundreds of brown bogs and sinuous lakes.

(*c*) **CLIMATE.**—The British climate is more equable than are the climates of countries in the same latitudes in Eurasia and North America. It is essentially a temperate marine climate, largely determined by the prevailing south-westerly winds and the geographic position of the islands. They lie in the track of cyclonic depressions, (frequently getting the south-eastern rainy quadrants), advancing circular storms which carry in their train a rapidly changing sequence of weather; hence Britain's proverbially changeable weather, the type most universally and uniformly stimulating to activity, adaptation, and initiative. The pressure conditions which largely govern the winds, temperature, and rainfall of Britain are: the tropical belt of high-pressure; a more or less permanent stationary anticyclone in the neighbourhood of the Azores; the polar ring of low pressure, represented by a permanent depression in the neighbourhood of Iceland; and the Eurasian system—a winter anticyclone centred over north-east Siberia, and a summer cyclone centred over the Iran plateau. On the northern side of the Azorean anticyclone the strong south-west to west current prevails, and in this current are found the cyclones which cross the British Isles on the average once in every ten or eleven days. In summer the tropical high-pressure intensifies and moves farther north, and the track of the low-pressure centres along its northern side passes farther to the north. The prevailing south-westerly winds are modified in this way by currents sweeping down from the north or north-west behind the depressions. These currents approach the British Isles from the north-west or west, and being relatively cold, the temperature of the north-west coasts remains low. The cyclonic westerlies are rain-bringers, which, on reaching the mountainous west, are forced upwards and being cooled adiabatically give much cloud and precipitation to the west. The eastern districts are in the rain shadow, thus experiencing warmer and drier conditions, and longer, though never great, periods of bright sunshine. In winter, the track of the depressions lies more across the British Isles as the anticyclone recedes southwards. The western coasts then come under the influence of winds mainly south-westerly, which bring them abundant precipitation and considerable oceanic warmth. On the other hand, the eastern coasts are often subjected to icy currents coming from the western borders of the Siberian anticyclone over the vast continental plains. Continual changes in the pressure systems make British weather the more uncertain, and weather-forecasting extremely difficult. Oceanic effects are remarkably exhibited by the direction of the isotherms in summer and in winter. Summer isotherms run generally in an east and west direction, though there are marked irregularities. Over the sea they tend to bend southwards, while inland the tendency is northwards. In winter the isotherms run north and south, latitude having little influence. Winter warmth is not due directly to the sun's rays, but to the winds coming from more southerly latitudes over the warm North Atlantic Drift and a relatively warm ocean, and the rain warmth (latent heat) set free by the deposition of frequent rains. The Atlantic thus dominates the winter climate. South-east Britain shows the greatest range of temperature, over a large area the January mean temperature being less than 38° F., the July more than 62° F. Most equable conditions are experienced in western Ireland and south-west England, where the mean annual range is only about 16° F. Rainfall is most evenly distributed over the islands, but is heavier during the winter half of the year, and on the western half of the area. Much of the west receives a mean annual rainfall of between 40 and 60 in.; whereas much of central England and the east coastal districts receive from 25 to 30 in. only.

Effect of Climate. To the high humidity of the atmosphere, the frequent cloudy skies, the heavy rainfall, and the prevailing cool or cold temperatures are due the subdued tones of the landscape, the ease of working in the textile manufactures, the love of open fires—the symbol of the British home—the need of strong stone and brick houses with sloping roofs, the vigorous sports, and the stimulus to work and to achieve; and possibly, in large degree, the sombre dress, the dogged perseverance, the clear outlook, and the deliberation of the British race.

(*d*) **VEGETATION.**—In the bulk the vegetation of Britain differs in no essential respect from that of the western region of cool-temperate deciduous forest. The scenery is typically that of the west European undulating park, where pasture and meadow predominate over the carefully cultivated area, and small patches of forest, mostly of oak, birch, maple, and ash, add beauty to the landscape. Vast forests, which once covered the greater portion of the country, have since early times been greatly reduced by the needs of agriculture, manufacture, and warfare, and at the present time less than 5 per cent of Britain is wooded, a proportion much less than that of most other European countries. It is doubtful, also, whether the wooded portions are genuine vestiges; more probably, all the existing woods have been planted. Urgent necessity is now compelling afforestation in regions such as the Scottish Highlands, where agriculture is almost or wholly impossible. On the uplands and highlands four zones of vegetation may be distinguished: the lowest is that of oak and beech woods; higher, that of poorer oak and Scotch pine; still higher that of forest intermingled with hill pasture; and, finally, come the moorlands. Above the oak belt, 700 to 900 ft., the conifers accompanied by the birch remain in almost exclusive possession, up to, in places, 2,000 ft. Moorlands, peat bogs, wastes, and alpine pastures rise above the conifers. British mountains lack the larch, the Norway spruce, the silver fir, the arolla, and the mountain pine, and show only the Scotch pine, yew and juniper. Poverty in plant-forms is doubtless due to early separation from the continent. In the lowlands, moors extend on the poor glacial soils, and the Scotch pine, in company generally with low heather, marks the occurrence of poor, dry soil. The wet, high peat bogs of Ireland and northern and western Britain in ill-drained areas, supplied with pure siliceous water, owe their origins to the enormous development of sphagnum moss, sedges and cotton grass, whose dead remains putrefy under conditions of excess of moisture and lack of air. On the Atlantic fringe the mild climate weakens the seasonal rhythm, and there is a tendency to a prolonged, though less active growth period, which gives a sort of broad, tender-leaf evergreen, and a sense of evergreenness in the lawns and succulent pastures, and the shrubs of the undergrowth.

(*e*) **FAUNA.**—The brown bear, wolf, wild boar, reindeer, and beaver, in Roman times made Britain their habitat ; but they have long been exterminated. Wild cattle, however, may still be seen in Chillingham Park, Northumberland, and Cadzow Forest, Lanarkshire. Stags, roebucks, fallow and red deer are kept in many private parks, and are stalked on the Scottish Highlands and Exmoor, and in south-west Ireland. The polecat, common brown hare, many members of the weasel family, the mole and vole, abundant in Britain, are absent in Ireland. Much sport is afforded by the fox, hare, otter, and rabbit. The only reptile known in Ireland is a small lizard, and the viper is the only poisonous snake found in Britain. Game-birds—pheasant, partridge, and grouse—often carefully preserved, are numerous ; and wild song-birds, the best known of which are the nightingale, skylark, blackbird, thrush, linnet, finch, and robin, are particularly numerous and varied. Eagles are occasionally seen in Scotland and Ireland, and owls and hawks are common. Woods are the resorts of squirrels, magpies, and jays ; but jackdaws and crows favour the near neighbourhood of man. Reclamation of land has reduced the number of waterfowl, but sea-fowl abound on British shores. Migration is a characteristic feature of a very large number of birds. From the wild swan to the willow wren they come and go with the seasons. All the animals of economic value and most of those protected for sport, have been introduced at various times from other countries.

(*f*) **FORESTRY.**—British forests are rare. Woods and plantations cover only 5·3 per cent of England, 3·9 per cent of Wales, 4·6 per cent of Scotland, and 1·5 per cent of Ireland. The existing scattered forests include the well-known New Forest (400 square miles) in Hampshire; Dean (150 square miles) in Gloucestershire; Arden in Warwickshire; Epping in Essex; Sherwood in Nottinghamshire; Charnwood in Leicestershire; Windsor in Berkshire; and the wooded portions of the Weald. Less well known are the woods of Whittlebury and Salcay in Northamptonshire; Needwood in Staffordshire; and Ashdown in Sussex. Several of these forests have almost disappeared. The "Dukeries," the valley of the Wye, and parts of Aberdeenshire and Inverness are beautifully wooded, and the park-like distribution of the trees throughout the country in clumps, spinneys, coppices, and hedgerows, makes up a fairly considerable body of timber. Little British timber is now utilized; careful conservation is practised; and reliance is placed on foreign supplies. A national policy of afforestation has been recommended, and British forestry is being re-born. Pine forests have been planted on the Scottish Highlands, the Pennines, the Welsh plateau, and Exmoor, which will eventually yield good timber, and regulate the water supply to the rivers and the falls for electrical power; and reclaimed coastal lands have been planted with the maritime pine.

(*g*) **FISHERIES.**—Judged by the number of men engaged, the amount of capital invested, the importance of the food products obtained, and the virile type of men created, fishing is, next to agriculture, the greatest of British industries. "The total number of whole-time fishermen is upwards of 125,000, while there are as many half-timers. Taking the whole industry, fishermen, curers, distributing agents, etc., it may be estimated that it gives support to one-twentieth of the population, while the capital sum directly invested must be about £200,000,000." (*J. Stanley Gardiner.*) The temperate shallow seas are prolific in demersal and pelagic fishes. Conditions of light, salinity and temperature of the waters, the oxygenating and food-distributing action of the tides, and the planktonic pastures, are highly favourable to fish life. Life in the sea is now the subject of much earnest research, which promises results of great value to the fishing industry, especially in connection with the migratory habits of certain fish.

In range and importance the British fisheries have steadily evolved to the position of the best manned and equipped of all fishing industries. Limited, at first, to freshwater areas, they expanded to coastal and, finally, to deep-sea fishing over a range of 3,500 miles from the White Sea and Iceland to the south of Morocco. Deep-sea fishing demands rapid transport to markets and low temperatures for the preservation of the food product; and, therefore, owes its development to the advent and growth of steam transport, the use of ice, and capable organization. Some 3,000 large fishing-boats and 7,000 other sea-going boats, in addition to a large number of smaller craft are engaged in fishing, and land in British ports in normal years about £30,000,000 worth of fish. Herrings are most abundant in the North Sea on the coasts of Scotland and England, but they abound in all the shallow waters from the White Sea to the Bay of Biscay. Coming into the shallow waters to spawn they are taken in great quantities, the fishery beginning in the north of Scotland in early May, arriving in Yarmouth in September, and reaching its height there in November. Nearly every port on the North Sea is a herring port, but Wick, Peterhead, Fraserburgh, Aberdeen, Grimsby, Hull, Lowestoft, Yarmouth, and London are the most important. On the western coasts, Inverary is the port for the celebrated Loch Fyne herrings; and Mallaig, Stornoway, Peel, and Fleetwood have important fisheries. In most of the Scottish ports large numbers of herrings are pickled in brine and exported to the Continent; while Aberdeen and Yarmouth salt and dry them in wood smoke, when they are known as kippers and bloaters. The pilchard fishery is carried on off the coasts of Cornwall and Devon, engaging the fleets of Penzance, Padstow, Brixham, Teignmouth, Falmouth, St. Ives, Porthleven, Mevagissey and Newlyn. Sprats are caught in many places round the coasts, but more especially in the Thames estuary, where, mixed with tiny herrings, they form the famous Greenwich whitebait. At Plymouth, mackerel fishing is carried on all the year round, but in the colder months the fishermen have to range the deeper, farther, warmer waters. In early summer the warmer waters tempt the mackerel northwards, and large hauls are made off the coasts of Norfolk and Suffolk, and western Scotland and Ireland. Cod prefers the rocky or stony floors of the northern seas. On the English coast north of the Humber and on the Great Fisher Bank, and off the coasts of Iceland and the Faröes, large quantities are taken. Sailing smacks from Grimsby and Harwich work the North-Sea grounds, but the distant ones engage steam trawlers from Grimsby, Hull, Aberdeen, and Fleetwood. Though important, these cod fisheries are not comparable with those of the Lofoten Islands and the Grand Banks. The ling is most abundant near the Orkney, Shetland, and Faröe Islands, and hake and whiting are taken in greatest numbers on the southern coasts of England and Ireland. Haddock and plaice form the staple products of the trawl in the northern part of the North Sea, but plaice are also caught in great numbers on the Dogger Bank, the Great Fisher Bank, the English coast north of the Humber, and off the shores of Iceland. Halibut, the largest flat-fish known, is taken off the shores of Iceland and the Faröes by trawlers from Grimsby and Hull. The Bristol Channel, the English Channel, and the southern half of the North Sea provide the best environment for soles and turbots, and men from Plymouth, Brixham, Lowestoft, and Ramsgate take part in the fishery. Eels are largely caught in the Bristol Channel, but the gigantic conger is mainly taken off the rocky coasts of Cornwall. Lobsters inhabit rocky pools, and are very numerous off the north-west of Scotland and Ireland. Crabs, prawns, and shrimps are found on all the sandy beaches, and are especially plentiful in the Wash. The most productive oyster beds are those of Whitstable, and the Colne and Blackwater estuaries. Mussels are obtained chiefly in the Firth of Forth, the Wash, and Morecambe Bay. Most British rivers, especially the Tay, Spey, Tweed, Bann, Severn, and Eden are noted for their fisheries, eel, salmon, and trout being the chief products.

Grimsby and Billingsgate are the great fish markets, and from them and all the chief fishing ports fast trains carry the fresh and cured fish to the great industrial centres. The normal annual pre-war catch was estimated at 25,000,000 cwts., valued at £15,000,000. Seven-tenths of this enormous total was discharged at English ports, more than a quarter at Scottish ports, while Irish ports received less than £500,000 worth. Further points of interest are that the North Sea yields more than half of the fish taken; that the herring, of which more than 3,000,000,000 are caught annually, is one of the cheapest and highest in food value of all fishes, and more important than all the other kinds of fish put together; and that the North-Sea ports secure four-fifths of the fish landed in England and Wales.

(*h*) **AGRICULTURE.**—Agriculture, the basis of all culture, is, judged by the number of workers engaged in it, the leading British industry. Highly scientific mixed intensive farming is, obviously, a necessary and marked feature of British agriculture; its yields of crops are very high; its animals set the standard for the world; its farms, comparatively few of which exceed 300 acres, are becoming more numerous with a consequent diminution in size; ownership of its lands by the cultivators tends steadily to increase; and scientific research is gradually finding out the nature of the soil and its inhabitants, the remedies for plant diseases, and the division of the country into natural agricultural regions based on climatic and soil factors. British farming has to face, however, the competition of "new" countries employing extensive cultivation; and this has caused during the last half century the passage of 3,500,000 acres of ploughed land into pasture, in spite of the fact that arable land yields twice the produce in money value and three to five times the food value compared with grassland. It is true that the growth of allotments and small holdings, the utilization of waste lands, and the spreading of agricultural education, are partially solving the depopulation of the rural districts and thus helping to preserve a healthy balance between town and country; but British agriculture in order to retain its proud position, gained only by centuries of effort, needs more co-operation among its members to secure better transport, manufacturing, and marketing facilities, and the joint use of the best implements and machinery, the solving of the labour problem, and the greater application of science to its problems. Its hope in the future lies in science, and the vigour, initiative, and adaptability of its farmers.

Arable Land. Nearly one-third of England is arable land, but Scotland, Wales and Ireland have each less than 18 per cent devoted to cultivation. Permanent pastures, often of a rich type, cover more than 40 per cent of England and Wales. The proportion in Ireland and Scotland, and especially the latter, is much less; but they possess a much greater area of poor grasslands on mountain and heath. The soils of the uplands, notably those of the most ancient in the north-west, are often thin, and, therefore, more suitable to pastoral pursuits than to cultivation. On the lowlands rich deep soils occur over large areas. Excellent soils favouring the dairy industry are those of the central Irish plain and the western lowlands of Britain. The clayey loams of intermixed limestone, sand, and clay of the eastern plain of Britain and the drained alluvium of the Fen district are of unusual fertility, and very favourable to cereal and vegetable production; while the thin, dry soils on the limestone and chalk heights furnish sweet short grass, relished by the wool type of sheep.

Pasture Land. Pasture grass is the characteristic crop of the Homeland, but its greatest luxuriance, lusciousness, and tenderness are attained in the western wet lowlands, which are, therefore, ideal for dairy cattle. British uplands of over 1,000 ft., and regions where the annual rainfall is over 40 in., are either near to or beyond the limits of successful cultivation, and are, in consequence, devoted chiefly to the pastoral industry. Cattle have wonderfully increased in weight from the 400 lb. carcase of Saxon days to the 1,200 to 1,600 lb. carcase of to-day. They number approximately 12,000,000, five-sixths of which are almost equally divided between England and Ireland. In the west they are bred mainly for milk; in the east and north for their beef. The most noted dairy types are the Holstein, Ayrshire, Jersey, Guernsey, and Kerry; the best beef types are the Hereford, Aberdeen Angus, and Devon; while the Red Poll, South Devon, Welsh black, dual type of Shorthorn, and Longhorn, serve the double purpose of milk and beef. Noted cattle districts are the south-west peninsula, Pembroke, Anglesey, Carnarvon, Carmarthen, the lowlands of Cheshire, Hereford, Lancashire, Yorkshire, Derbyshire, Staffordshire, and Leicestershire, the extreme south-west of Scotland, Fife, and the central plain of Ireland. On the clays of Somerset and Gloucester, and on the red horseshoe plain of the English midlands, the finest cheese (Cheddar, Double Gloucester, Cheshire, and Stilton) is produced. Ireland is noted for its butter, and Devonshire for its clotted cream. In the vicinity of the great industrial centres the dairy farmer specializes in milk and eggs; in the remoter districts he confines himself to butter and cheese. The production of eggs, in recent years, has become a scientific and lucrative industry. Horses are largely reared in the drier parts of western and northern England and south-west Scotland,

and in the less boggy parts of Ireland, especially where oats are widely grown. They are still important for military, sport, farm, and transport purposes ; and their number, approximately 2,000,000, remains normally the same despite the growth of mechanical traction. For heavy draught work in town or country, the Shire, Clydesdale, and Suffolk types are the best ; for lighter work the Cleveland Bay, Yorkshire Bay, the hackney, and the trotting horse ; and for sport the hunter and the thoroughbred. Small mountain and moorland ponies are bred in the Shetland Isles, the highlands of Wales and Scotland, Galway, Exmoor, Dartmoor, and the New Forest. Some of these, fortunately in decreasing numbers, are used in the coal-mines, but most are used for very light draught and for pleasure purposes. Sheep, of prime importance to Britain in the Middle Ages when wool was her chief export, even now number approximately 27,000,000, a figure which places the Homeland among the highest of sheep-rearing countries. More than half of the sheep are in England, and nearly a quarter in Scotland. They flourish on all the uplands, those on the drier east yielding usually the better wool (10-12 lb. per fleece), and on the wetter west the better mutton. Famous breeds are the long-woolled Leicester, Lincoln, Cotswold, Devon, Roscommon, and Romney Marsh ; the fine, medium-woolled South Devon, Shropshire, Dorset, and Hereford ; and the small excellent mutton types of the more mountainous country—the Welsh, Dartmoor, Exmoor, Cheviot, and Black Face. British pigs, bred for pork and bacon, are fed on the offal of the corn farms, the waste products of the dairy, and foreign maize. They number over 4,000,000, England possessing more than half, and Ireland more than a third. The chief breeds are the Large White Yorkshires and Ulsters ; the Large and Small Blacks of Devon, Cornwall, Essex, Suffolk, and Berkshire ; the red Tamworth and the Lincoln. Ireland, Wiltshire, Cumberland, and Yorkshire are noted for their bacon and hams. Goats provide a very economical way of utilizing the poorest lands, but are of little importance, except in Ireland, which has nearly half a million.

Crops. The small size of British farms, together with the high price of land consequent on the dense population (47,000,000), the keen competition of foreign countries, and the variability of the climate, compels scientific, intensive cultivation. Wheat, the most important bread product, thrives best on the clayey loams of the drier sunnier parts of eastern Britain, notably in south-eastern England, the vale of York, the merse of Berwick, and the Lothians. The acreage is normally about 1,800,000 (nine-tenths in England); and the high yield (30 to 35 bushels per acre) should, with the future introduction of the very high yielding "strong" varieties developed by British research on Mendelian lines, be much greater. Only one-fifth of the wheat and less than one-third of all the foods required are, as yet, home-grown. Oats flourish under a cooler and moister climate than wheat and barley, and cover an acreage of approximately 4,000,000, an extent greater than that of wheat and barley together. They are grown in nearly all parts, except on the higher hills, but Scotland, especially from Fife to Banff, Northern Ireland, and north-east, south-east, and south-west England are the chief producing regions. Barley is widely grown. Approximately 2,000,000 acres are devoted to it, three-quarters of the acreage being in England. East Anglia, the Midlands, north-east England, eastern Scotland, Leinster, and Munster are the most important areas. The cultivated area under rye and maize is almost negligible. Their chief use is as green fodder. This is essential in the case of maize, which fails to mature under the climatic conditions. Peas and beans grow well in the rich soils of the Fen district, East Anglia, and the Midlands, and in the counties of Perth, Stirling, and Ayr. The acreage is about 400,000. Flax, grown in quantities very inadequate for the needs of the linen industry, is practically confined to north-east Ireland and to certain parts of the English Midlands, and the east of Scotland. Sugar-beet is in the experimental stage, but some success has been gained in East Anglia, and the plains of Lancashire and Yorkshire. Minor crops are: hops, produced mainly in Kent (more than a half), Hereford, Sussex, Worcester, and Surrey; mustard in East Anglia; and celery in south Lincolnshire and the Fen district. Near all the large towns there are stretches of "market gardens," which supply the town markets with vegetables and flowers; and 3,000 acres of glasshouses, many in the Lea valley, furnish grapes and tomatoes. Early fruit, vegetables, and flowers reach London and other centres from mild south-western England, the Scilly Isles and the Channel Isles. Fruit-growing requires rich soils, protection from cold winds, and mild springs. Kent, with half the orchards in Great Britain, produces strawberries, cherries, apples, pears, and plums. Hampshire, Cambridgeshire, Cheshire, Yorkshire, and Strathmore are noted for their strawberries, and the finest raspberries come from the Carse of Gowrie. Hertfordshire, Bedford, and Buckingham produce large quantities of apples and plums; while the belt of country from Hereford through Gloucester and Somerset into Devonshire is celebrated for its apples and pears, from which are obtained the famous cider and perry of the west. Gooseberries and red and black currants are grown throughout the country. In Scotland and Ireland the best fruit-growing regions are the counties of Perth, Lanark, Armagh, Antrim, and Cork. The only British nuts, which have proved successful, are Kent cobs and walnuts, and Norfolk chestnuts. Hay, a necessity for winter fodder, shows an acreage of nearly 10,000,000, approximately two-thirds of which are in England and more than a quarter in Ireland. Root crops—mangolds, turnips, swedes, carrots, and parsnips—introduced in the seventeenth and eighteenth centuries, revolutionized British stock-rearing and the British meat supply. Prior to their introduction many cattle had to be slaughtered in the autumn; and their flesh salted down for winter use increased the love for spices and beer, and the spread of skin diseases. The acreage is nearly 2,250,000, two-thirds being in England and Wales, and more than a sixth in Scotland. Though their cultivation is widely spread, eastern England and the Scottish Lowlands yield the best crops. Potatoes flourish in the moist west, but reach their greatest perfection in eastern England and Scotland, and in Northern Ireland. Of a total acreage of nearly 1,250,000, Ireland claims nearly half.

(*i*) **MINING.**—To her great mineral wealth, especially in coal and iron, and its comparatively early utilization in manufactures, Britain largely owes her present world position of power. The early use of coal gave Britain a long lead over continental nations; localized her industries; compelled the making of better communications; and caused her to seek wider markets and gain colonies. Against the advantages in mining comprised in the wealth of minerals, the skill and energy of the workers, the abundance of capital, the excellent communications, the employment of the best machinery, and the nearness of mining regions to the coasts, must be placed the long period of working the mines (which has necessarily resulted in deeper mines with consequent diminishing returns to the same amount of capital and labour), the comparatively thin and sloping seams of coal, and the competition of younger mining countries. Britain, nevertheless, ranks amongst the foremost mining countries, and should steam-power be displaced in the future by electric or other power, her tides and torrential streams, and her scientific research workers are potent, hopeful factors.

Coal. Coal is Britain's greatest source of non-metallic wealth, her greatest ballast cargo, and one of her chief exports. The chief producing regions are the basins and synclines on the margins of the uplands. In the Scottish Lowland Rift valley the strata have been thrown into basin-shaped curves, within which denudation has spared the coal measures; in England, coal measures once covered the whole of the Pennine plateau, but are now found only on the flanks; in Wales they are found where the carboniferous rocks bend down on the eastern and south-eastern sides of the plateau; while in the Irish plain, except in a few isolated patches, they have been worn away. The Pennine coal-fields occur near the base of the lower slopes. They are the Northumberland and Durham; the Cumberland; the Lancashire (including north-east Cheshire); the York, Derby, and Nottingham; and the Midland divided into the North and South Staffordshire, the Warwick, the Shrewsbury, the Coalbrookdale, and the Forest of Wyre. The small coal-field of North Wales is probably a westward extension of the North Staffordshire. Around the Bristol Channel are the coal-fields of South Wales, the Forest of Dean, and the Bristol. Apart from the small Sanquhar field in the Southern Uplands, all the coal of Scotland is mined in its great Midland field in the countries of Ayr, Lanark, Linlithgow, Stirling, Clackmannan, Fife, and Midlothian. Coal mining in Ireland is unimportant. Less than 100,000 tons are annually raised, chiefly in the Ballycastle, Castlecomer, Dungannon, Lough Allen, and Tipperary fields. During recent years shafts have been sunk through the newer rocks to the concealed fields in Kent and the north-eastern plain, with encouraging results. In 1913, no less than 287,000,000 tons of coal were raised, but the present normal average is only 250,000,000 tons.

The most productive fields are the York, Derby, and Nottingham with over a quarter of the output; the Northumberland and Durham with nearly a fifth; and the South Wales with over a sixth.

Normally, about a quarter of the product is exported, and half of this is sent from the ports of South Wales. The valuable smokeless steam-coal and the bulk of British anthracite are produced by the coal-field of South Wales. Peat for fuel is obtained in many parts of Ireland, Dartmoor, the Welsh plateau, south-west Lancashire and Cheshire, the Pennine moors, the Southern Uplands, and the Scottish Highlands. The oil shales of the Central Scottish Lowlands, chiefly in Linlithgow, yield annually over a million barrels of oil, and many tons of ammonium sulphate.

Stone. In the older regions of the British Isles local stone is largely used for building purposes, whereas in the younger lowlands of the south-east brick houses are common. The hard sandstones are the chief building stones, though the oölitic limestones are also used. For massive structures and for ornamental stones, the granites of Aberdeen, Galloway, Galway, Shap, and Dartmoor rank as excellent; for roofing, the slates of Penrhyn, Llanberis, Festiniog, Corris, Tilberthwaite, Easdale, Ballachulish, Cork, and Tipperary are the best; and for paving and "road metal," the igneous rocks of the Highlands, the Southern Uplands, North Wales, the Lake District, Devon, the Mourne Mountains, and the Wicklow Hills provide the most durable material. Bricks are made chiefly in the Thames valley (London stock bricks), Staffordshire (blue bricks), Hampshire (Fareham red bricks), and in Kent and Hertford (Gault bricks). Firebricks are manufactured from the saltless soils of the fireclays found in the coal measures, notably at Stourbridge in Worcester, and Tudhoe in Durham. The coarse clay of the "Potteries" is used for the saggars in which the china is baked, but, for the fine porcelain, the kaolin or china clay (decomposed granite) of Cornwall is imported.

Salt. This mineral occurs in the belt of red rocks which runs in a great horseshoe round the Pennines, and is exploited in Cheshire (the Weaver valley), Stafford, Warwick, Worcester, North Yorkshire, Durham, and Antrim. *Gypsum* is obtained mainly from the marls of the New Red Sandstone of Cumberland, Cheshire, Derby, Nottingham, and Durham; and the Portland cement industry flourishes wherever a navigable waterway cuts through chalk or limestone hills as at Rochester. *Flint*, used in the manufacture of glass and porcelain, is a product of the chalk escarpments of the south-east. Borrowdale, in Cumberland, formerly produced large quantities of *graphite*, but the supply is now practically exhausted. *Fuller's earth* is obtained in Surrey, Bedford, and Bucks; *ganister*, a hard compact sandstone, which forms the hearths of blast furnaces, is found in many of the coal-fields; and *limestone*, used as a flux in iron-smelting, as a manure in agriculture, and in the chemical and building industries, is extracted in most of the limestone and chalk regions.

Metals. *Iron* is the chief source of metallic wealth, but the home supply of 14,500,000 tons is insufficient for national needs; and is supplemented by ores from Algeria, Greece, Labrador, Spain, and Sweden. About 80 per cent of the ores come from the ironstones in the oölitic limestone belt, which runs across England from Portland Bill to the mouth of the Tees. The Cleveland hills, Lincoln, Leicester, Rutland, Northampton, and Oxford are the chief centres. Haematite, or kidney ore, is found in pockets and veins in the limestone rim which surrounds the older rocks of the Lake District, and in the limestones of North Wales and the Forest of Dean. The coal-measure ironstones of Lanark, South Yorkshire, Derbyshire, South Staffordshire, and South Wales, formerly of great importance, now supply only 8 per cent of the total output. In Ireland, active iron-mining is confined to the pisolitic ores in the basalts of Antrim. *Tin* has been mined in Cornwall since Phoenician times, and still yields an annual value of over £1,000,000; but the quantity of imported ore and metal from Malaya and Bolivia is twelve times as great. *Copper* and *zinc*, in insignificant quantities, are mined, the former in North Wales, Cornwall, Devon, Yorkshire, and the Wicklow hills, and the latter in Cumberland, North Wales, and the Lowther hills. Traces of the *precious metals* are found in the Wicklow and Welsh hills, but rarely in quantities sufficient to pay working expenses. *Lead* is mined in Cumberland, Durham, Flintshire, Derbyshire, and the Southern Uplands. The supply, however, is barely 5 per cent of the national needs, and many mines are on the margin of production. Bauxite, from which *aluminium* is extracted, is obtained from the Antrim plateau, and shipped for electric treatment to Kinlochleven in the Scottish Highlands.

CHAPTER XIII

THE BRITISH ISLES (NATURAL REGIONS)

SCOTLAND

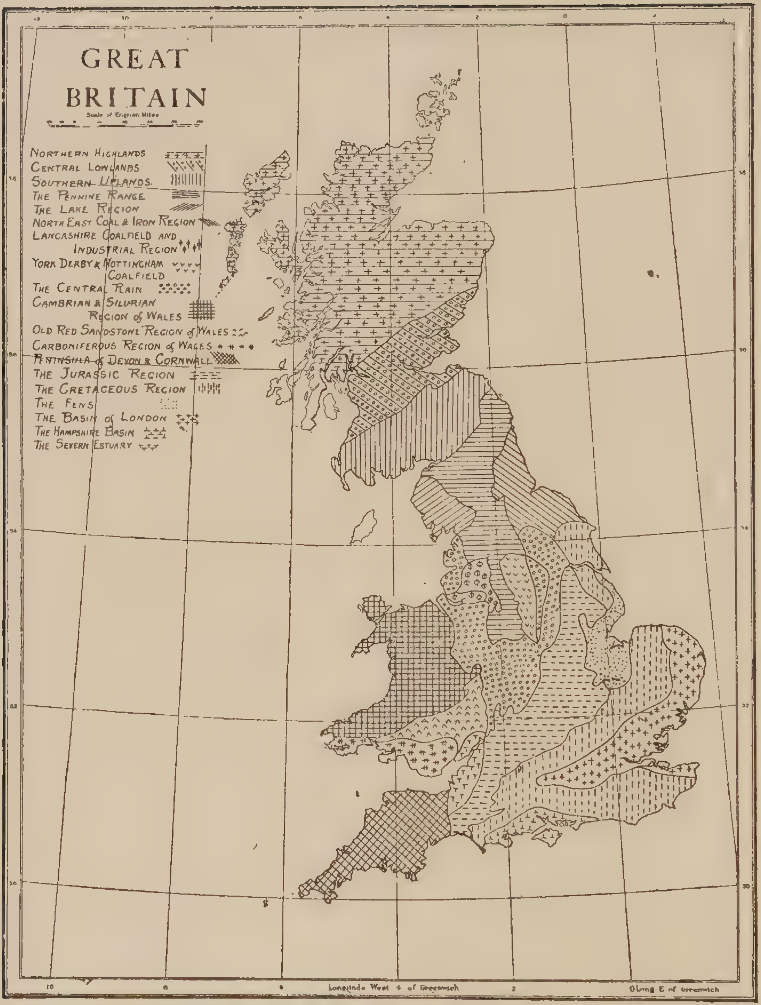
> " O Caledonia ! stern and wild,
> Meet nurse for a poetic child !
> Land of brown heath and shaggy wood,
> Land of the mountain and the flood."
>
> —*Scott.*

(*a*) THE SCOTTISH HIGHLANDS.

THE Highlands of Scotland rise wall-like from the Midland Rift valley, and comprise more than two-thirds of the total area of Scotland. They are the remnants of a plateau of ancient crystalline rocks, a result of the powerful atmospheric and glacial forces of past ages. The whole region has been so profoundly dissected and modified that it has been aptly described as a wild, tumbled sea of residual mountains. The long, narrow, deep rift valley of Glenmore, occupied by Lochs Lochy, Ness, and Oich, which have been artificially connected since 1823 to form the Caledonian Canal, separates the lower Northern Highlands from the higher Grampian Highlands. Awe-inspiring in their loneliness and severity, the Northern Highlands, carved from an old peneplain, show an easterly or south-easterly tilt. In consequence, the rivers flowing to the Minch are short and very rapid, while those flowing eastward are longer. Western sea-lochs of fiord type, scratched and polished rocks, scooped-out rock basins, ridges of morainic material, layers of boulder clay, and valley lakes throughout the Highlands, evidence the action of ice. The tilt of the original surface of the Grampian plateau was to the south-east, a feature evident in the trend of several of the river valleys. Longer courses, such as those of the Findhorn, Spey, and Upper Tay, are at right angles to this direction. These streams have cut their valleys in less resistant strata, which appear at the surface in long N.E.-S.W. bands or belts. A few exceptional rivers, notably the Dee and Don, flow eastwards. The greatest heights are in the north-west, where Ben Nevis, overlooking Loch Linnhe, attains a height of over

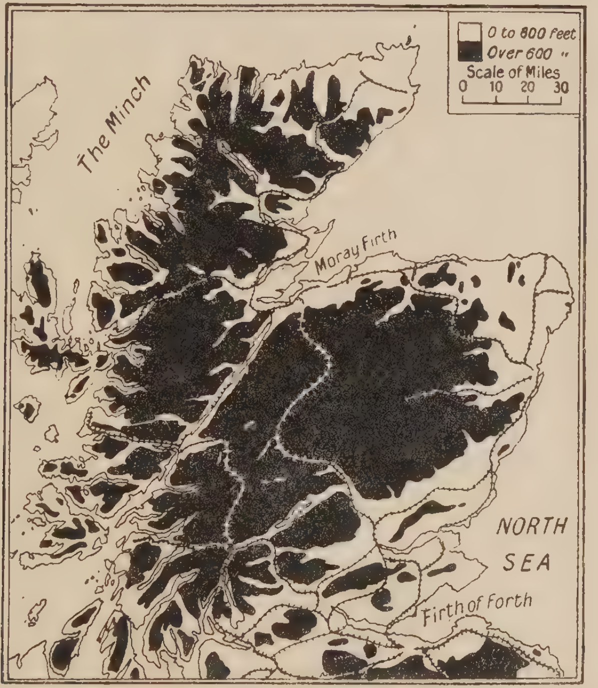
4,400 ft. (the highest summit in the British Isles); and near the source of the Dee, where Cairn Gorm, Cairn Toul, Braeriach, and Ben Macdhui all rise to 4,000 ft. Near Loch Lomond the scenery is particularly beautiful, and still more famed is the mountain, lake, and sylvan scenery of Loch Katrine and the Trossachs. The vast variety of rock materials, exposed in elevated positions to severe climatic weathering agents, give individual characters to the landscape. In the north-west the dark red sandstone has been shaped into huge pyramids; in the central and south-western counties white quartzite cones gleam in the sparse sunlight; while in the eastern Grampians, high, craggy moors, encircled with stupendous corries and precipices, indicate the site of the bosses of granite. Only at a few points does the plateau reach the eastern coast. In Caithness there is a fertile triangular lowland formed of Old Red Sandstone, and a similar formation occurs on either side of the Moray Firth, and penetrates Glenmore. Eastwards, the lowland continues to the Buchan peninsula, though here it is mainly composed of hard rock worn down almost to sea-level. The typical highland landscape is one of almost treeless moors, covered with peat bogs, heather, bracken, and poor grass, above which rise the rounded mountains, often bare and stony on their higher slopes and summits. In the glens the vegetation is more varied. The scattered coniferous and deciduous trees, beautiful lakes, rushing, peat-coloured rivers, and the gorgeous display of colour in the ferns, mosses, heather, and flowers of the glens, entrance the tourist in summer and autumn. In the shadows of the mountains, in the eerie glens, and amid the murmurings of pines, the often dreamy, melancholy, and sometimes ghost-like strains of the bagpipe have had their birth. Nowhere is the grandeur of a winter storm more impressive than when a cyclonic gale from the south-west hurls the breakers against the western headlands, howls up the glens, and fills all the gullies with foaming torrents.

Apart from the undeveloped water-power, there is but little wealth in the Highlands. Minerals are few; soils are often thin and poor; the climate is cloudy, damp, and raw; and routes are very difficult. Mining and agriculture are, therefore, very restricted. The western Highlander in many districts is compelled to be farmer, shepherd, and fisherman; and much reliance has to



NATURAL REGIONS OF GREAT BRITAIN.

be placed on the "tourist industry." Only such a dogged race as the mountain Scot is willing to wring from Nature a sparse livelihood, and glory in the dour conditions. Reserved and independent, keen-witted and indomitable, clannish and retentive of old faiths, languages and ideals, thrifty and yet poetical, the Highlander reflects his environment. The population is necessarily very small, barely one-tenth of that of the Midland Rift Valley, and depopulation for more than a century, encouraged by the poor returns to labour and the making of deer forests (open moorlands) for sport, still continues. Deer forests, grouse moors, salmon and trout streams count for much to the wealthy, but they do not populate. Though much of the area could be made more productive for agriculture, there is much that is too rocky and barren for crops or even sheep. Hope lies mainly in the systematic planting of



THE HIGHLANDS OF SCOTLAND.

forests. In the glens and on the lower mountain slopes the crofters cultivate small patches of root-crops and oats, and rear hardy sheep, and the shaggy-coated, long-horned, Highland cattle. On the eastern sill both climate and soil favour the growth of barley, oats, and potatoes, and the fattening of live-stock. The prosperous Moray lowlands have always been prominent in Scottish history. Fishing is important on all the coasts, though, naturally, it is carried on chiefly by the east-coast ports which face the richer fishing grounds, and have easier conditions for the dispatching and marketing of the fish. Wick, Peterhead, Lossiemouth, and especially Aberdeen, are leading fishing centres, and Strome and Mallaig on the west dispatch the catch of the Western Isles. Granite is quarried near, and exported from, Peterhead and Aberdeen. Slate and marble are obtained respectively from Ballachulish (Mull) and the neighbourhood of Loch Assynt. At the Falls of Foyers, and near Loch Leven, water-power is used for the manufacture of aluminium. "Lewis" and "Harris" tweeds, impregnated with the scent of burning peat, are made by hand in the cottages of the crofters, and local vegetable dyes are used. On Speyside and in certain isolated districts, local barley and potatoes have encouraged the establishment of whisky distilleries.

Communications. In rude times the Highlands were an almost inaccessible asylum to the clans. The Romans never penetrated the dark, forbidding plateau; and it was not till the eighteenth century, when roads were cut in various directions, that northern Scotland was thoroughly controlled by England. Roads, even to-day, are few and difficult, and there are fewer railways. The winding Highland Railway (L. M. and S. R.) between Perth and Inverness, shows notably the control that relief exercises upon the direction and length of railway routes. Leaving Perth, the line proceeds up the Tay valley in a north-westerly direction, and then goes up the valleys of the Tummel and Garry, tributaries of the Tay. Continuing, it passes through the narrow Pass of Killiecrankie; negotiates the great mountain barrier extending from Ben Nevis to Cairn Gorm, by means of the Drumochter Pass (1,500 ft.); and enters the Truim Valley, down which it runs to the Spey Valley. From Strath Spey it crosses the Slochd Mhuic Pass; enters the Findhorn Valley, over which it is carried by a viaduct;

and finally reaches Inverness by way of Strath Nairn and the Moor of Culloden. From Aberdeen the Great North of Scotland Railway (L. and N.E.R.) crosses the base of the Buchan peninsula to Elgin, where it joins the Highland line which continues along the coastal sill to Inverness, and on through Dingwall and Helmsdale to Thurso and Wick, both fishing ports, with steamer communication with Kirkwall in the Orkneys, and Lerwick in the Shetlands. A branch line runs across Ross and Cromarty to Strome Ferry and the Kyle of Lochalsh, whence boats ply to Stornoway in Lewis and Portree in Skye. The Caledonian Railway (L. M. and S. R.) has an important branch to the tourist centre, Oban, and the West Highland (L. M. and S. R.) line, following difficult routes, extends from the mouth of the Clyde to Fort William, and Mallaig. From Glasgow to Oban and other west-coast towns, the easiest routes are by sea through the Crinan Canal, cut through the depression of upper Knapdale in the Kintyre peninsula. The Caledonian Canal unites regions which will always be populated thinly, hence its commercial value is small, only tourist steamers and the fishing fleets utilizing its waters. *Inverness* (21),[1] at the head of Glenmore, is the natural capital of the Highlands, controlling routes from the east, the south-east, the south-west, and the north. It has brewing and distilling industries, and manufactures woollen goods. *Aberdeen* (159), the fourth largest city of Scotland, stands on the borders of the Highlands, between the mouths of the Dee and Don, and has a fine harbour protected by breakwaters at the mouth of the former river. It thus commands the traffic up and down these valleys, and that passing north and south along the coastal plain. Its industries include granite-quarrying, fishing, ironfounding, engineering, motor-boat building, the manufacture of cotton, woollen, linen and jute goods, the making of jam, and the distilling of spirits. It has a famous university, and an important cattle market, and its buildings of sparkling granite have earned for it the name of " the granite city."

(*b*) THE ISLES OF SCOTLAND.

The Orkney Islands. The Orkneys are separated from the mainland by the Pentland Firth, through which the tidal current, racing along at the rate of 10 or 11 miles an hour at high-tide, proves troublesome to shipping. Like Caithness, they consist of Old Red Sandstone overlaid in parts by glacial deposits, and the bedding planes and master-joints have aided the formation of immense stacks and skerries. On the whole the islands are low, and the fertile soil, cleared of its peaty covering, yields fair crops of oats and turnips. Lying open to the desiccating action of the western winds, tree growth is prevented, and peat is the only fuel. Sheep and cattle are reared, and fishing is an important industry. Kirkwall, on Mainland, is the chief centre. Scapa Flow, south of Mainland, controlling the entrance to the northern portion of the North Sea, became a base for the Navy during the Great War.

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[1] Populations of towns are given in thousands.

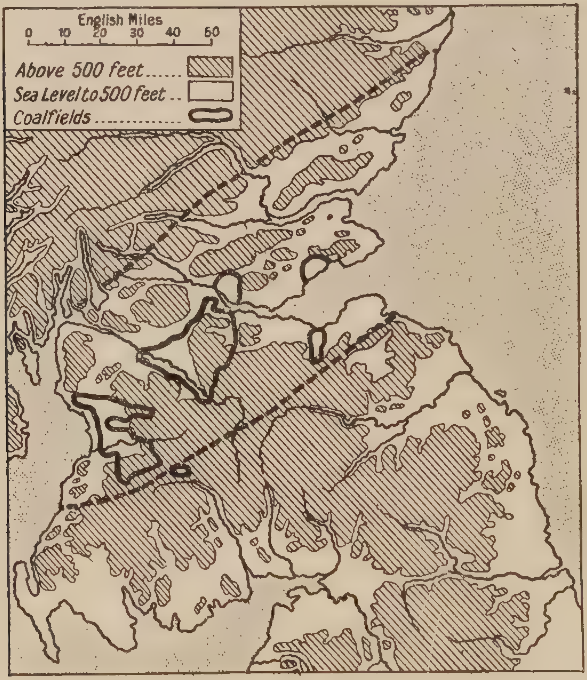
The Shetland Islands. These islands lie about 100 miles north of the Orkneys. They are composed of hard, igneous rock, and are a true remnant of old Caledonia. The magnificent rock scenery of the west, the fiord type of coasts, and the subdued Highland scenery, recapitulate the northern Highlands. Only about one-thirtieth of the area is cultivated, chiefly with oats, but the rearing of sheep, cattle, and the tiny Shetland ponies is important. The fleecy wool of the small sheep is made into shawls and hosiery by the women in their own homes. Fishing is a principal occupation, and some wealth is gained by the utilization of the immense quantities of kelp for iodine and as a manure. Lerwick, on Mainland, is the chief centre.

The Western Isles. This group of islands is divided into the Inner Hebrides, which adjoin the coast, and the Outer Hebrides, lying kite-like beyond the drowned rift valley of the Minch. Two distinct types of structure and scenery are evident in the Inner Hebrides. The islands of Islay, Jura, Colonsay, Scarba and Luing are outliers of the Highlands; but Mull, Muck, Eigg, Rum, Canna, Skye, and Staffa are largely formed of volcanic rock, the basalt covering probably extending long ago in a continuous mass to the Antrim plateau. The basalt of Staffa has formed great six-sided columns of rock, in which the sea has hollowed out the famous Fingal's cave. In structure and in scenery the Outer Hebrides are Caledonian. Their surface is studded with many bogs and lakes; and greyness of sky, sea and rocks, and absence of trees are characteristic features of the landscape. The islands act as a natural breakwater, so that the enclosed seas are relatively calm and abound in fish. Agriculture on the peneplain is difficult, for soils are rarely fertile and the climate is inclement. Fishing, the growing of a little oats, the rearing of sheep, and the making of the damp-resisting " Harris " tweed, are the principal occupations. Stornoway, in Lewis, is the chief centre. The industries of the Inner Hebrides resemble those of the Outer Hebrides, but agriculture is favoured with more fertile soils and is in a more flourishing condition. Portree, in Skye, is the chief centre. The islands of Bute and Arran, lying inside the Kintyre peninsula, are not very productive. They are, however, popular holiday resorts. Rothesay, on the beautiful Kyles of Bute, is the most important town.

(*c*) THE CENTRAL LOWLANDS.

The Scottish Rift Valley or the Midland Valley. This valley, lying between the Highland fault (Stonehaven to Kilcreggan) and the less easily distinguished great fault-line from Dunbar to Girvan, contains, notwithstanding its small area, not less than four-fifths of the total population of Scotland ; and in its fertile plains historical Scotland grew up, first round Perth, and later round Edinburgh. The Lowlands do not form a plain, and deserve their name only when compared with the Highlands and the Southern Uplands. Above the floor of the valley rise old, hard, igneous rocks, forming the steep castle crags of Edinburgh, Stirling, and Dumbarton, and a double line of heights extends along the northern and southern margins, running somewhat parallel to the boundaries. The Northern Heights pass from Arran to the Renfrew Hills, Campsie Fells, Lennox Hills, Ochil Hills, and Sidlaw Hills, whilst the southern set is represented by the Lanark Moors and the Pentland Hills. Strathmore or the Great Plain, a fertile plain of Old Red Sandstone, lies immediately under the Grampian edge and north of the Sidlaws ; while a smaller plain, the fruitful Carse (or garden) of Cowrie, is situated between the Sidlaws and the Firth of Tay. Between the Pentlands and the Firth of Forth are the Lothian Lowlands, a region underlaid chiefly by carboniferous rocks ; and, on the west, are the Ayrshire plain, and the Clyde basin, in all of which the coal seams have been preserved from denudation. The four hill-masses of the northern series are separated by the three great Lowland rivers—the Tay, the Forth, and the Clyde—and subsidence has brought the estuaries of the two latter rivers to within 30 miles of each other, thus permitting shipping to penetrate Scotland's industrial heart. Dumbarton guards the Clyde gap, Stirling the Forth, and Perth the Tay gap.

The great development of this region is due to the richness of the soils, derived from various rocks and intermingled by glacial and river action, which has aided the always thorough Scottish farming, the main occupation till comparatively recent years; the climate, which though not ideal is not adverse to agriculture; the dampness, especially on the west, which favour textile manufactures; the comparative ease and perfection of communications by sea, river, canal, and railway, which helped to establish local and world markets; the extensive deposits of coal and iron, which localized the industries;



Midland Valley and Southern Uplands.

the thriftiness, perseverance, and determination of the Lowland Scot, which has led to success in agriculture, manufactures, and trade ; the position of Edinburgh with Leith for trade with England, Scandinavia, the Low Countries and France in days before the Industrial Revolution ; and later the rise of Glasgow, ideally placed for American trade, and helped by the creation of a deep Clyde waterway, the work of Watt, Telford, and Galthorne. Scottish farmers are extremely hard-working and scientific. Where the soil is stiff and hard they often get good yields by thorough cultivation ; and, in spite of the lack of summer heat, their farming proves successful. Generally speaking, the lowlands are agricultural, the hills pastoral ; but specialization is evident in the pastoral pursuits of the wetter west, and of arable land in the drier east. Wheat is grown chiefly in Fife, Linlithgow, Haddington, Midlothian, and Forfar ; potatoes are an important crop in Fife, Haddington, Linlithgow, and Midlothian ; barley is widely cultivated, and especially in Strathmore for the use of the whisky distillers ; oats, the chief corn crop, are raised throughout the valley, though Haddington and Linlithgow lead ; and root crops, specially important for winter food, are grown on all the farms. Fruit-growing—apples, pears, plums, raspberries, and strawberries—is very successful in the Carse of Gowrie, Strathmore, and Strathclyde. The mildness of the Ayrshire coastlands favours the raising of early potatoes and spring flowers, and here and in Lanark the luscious pastures and excellent markets stimulate the dairy industry.

The coal of Scotland is practically confined to the Central Plain, the best coal-seams being found in the lower carboniferous rocks instead of in the coal measures as in England. The most westerly of the coal-fields is that of the Ayr basin, where coal is mined from Cumnock to Dalry, and exported from Ardrossan, Ayr, Irvine, and Troon to Northern Ireland. Local clay-band iron ore is smelted at Ayr, Dalmellington, Kilwinning, Glengarnock and Muirkirk, and is supplemented by foreign iron ore. Kidderminster carpets are made at Ayr and Kilmarnock, the latter town having also important engineering works. The central or Lanark coal-field, which stretches across West Stirling to Clackmannan, mines nearly half the Scottish output, and has important supplies of black-band iron ore and calciferous sandstone. The iron and steel trades became, therefore, pre-eminent, but they need now great quantities of imported iron ores owing to the local shrinkage. On both sides of the Clyde estuary from Glasgow to the sea are the greatest shipbuilding and marine engineering works in the world. On the north side are Dumbarton, Bowling, Kilpatrick, Dalmuir, Clydebank, Partick, and Glasgow; on the south, Greenock, Port Glasgow, Renfrew, and Govan. The great smelting and engineering centres are Coatbridge, Airdrie, Motherwell, Wishaw, Kirkintilloch, Newmains, Shotts, and Falkirk (Carron works founded 1759). Oil, ammonium sulphate, and gas are obtained from the oil-shales at Coatbridge and Airdrie. The cotton manufacture, centred at Glasgow, Paisley (thread), Lanark, Hamilton, and Renfrew, has almost all the advantages of the Lancashire region. Stirling and Bannockburn are noted for plaids and tartans; Clydebank makes the Singer sewing machines; and Greenock has important sugar refineries. Machinery for mining, quarrying, and the textile industries, is manufactured at Glasgow, Paisley, and Motherwell; and chemicals are important at Glasgow, Dumbarton, Larkhall, and Falkirk. *Glasgow* (1,034), the chief town of the coal-field, is the second city of the British Isles, and the premier port of Scotland, almost monopolizing the Scottish-American trade. It owes its origin and early growth to its situation on the rich soils of the Clyde valley, within reach of a number of agricultural and pastoral districts; at a point where the Clyde could easily be crossed; and where the natural roads from Stirling, Edinburgh and the Forth, the southern roads from England viâ Annandale and the Plain of Ayr, and the Highland road viâ Dumbarton and Loch Lomond, meet. Not until the age of coal and iron and the growth of trade with America did it become a great city. The deepening of the river, due to the determination of its people, brought ocean-going ships to its docks, and the rich iron and coal-fields behind it fostered its manufactures, and made it a railway node. The Forth and Clyde Canal from Glasgow to Grangemouth provides a waterway for small boats, and, when the proposed ship canal is completed, Glasgow will probably gain extra European trade. Among its many industries are steel shipbuilding, engineering works of all kinds, sugar-refining, textile and chemical manufactures, and the manufacture of pottery. The eastern or Lothian coal-field, which extends under the Firth of Forth into

Fife, is a small one, and contains little iron ore; but it is estimated that about half the total available quantity of coal existing in the Scottish coal-fields lies in this basin. Hence, its importance should be greater in the future. Though much less industrial than the Lanark area, this region has important linen industries. Dunfermline and Alloa make fine linen; Kirkcaldy makes oilcloth from jute imported from India, and linoleum from cork imported from Spain; and Dundee (the chief) with Forfar, Arbroath, Montrose, and Brechin manufactures hemp, jute, and coarse linen goods. South of the Forth large industrial centres are absent, but Edinburgh has important brewing, milling, distilling, and printing trades, whilst paper-making is carried on in Penicuik and other neighbouring villages. Alloa, Grangemouth, Bo'ness, and Methil export coal; Roslin makes explosives; and Broxburn, Bathgate, and West Calder are engaged in the oil-shale industry. Arbroath, Montrose, and Dundee are important fishing centres, the last-named being one of the headquarters of the North Sea fishing fleets. Minor industries of the Midland valley are the distilling of whisky at Glasgow and Edinburgh, favoured by the abundant supplies of grain, potatoes, and pure water; and the jam and marmalade making of Dundee, fed by the fruit of the Carse of Gowrie, the beet sugar of the Baltic countries, and the oranges of the Mediterranean lands.

Until about a century ago, the larger cities were in the east; and Glasgow was the only western city with a university, whereas both St. Andrews and Edinburgh on the east had universities, and, to-day, attract the literary and artistic life of Scotland. *Edinburgh* (420), the banking, insurance, legal, literary, educational, and ecclesiastical capital of Scotland, owed its beginnings to its castle rock, which commands the narrowest part of the coastal plain between the Pentlands and the sea, where upland, lowland and sea meet, and routes converge. Growing with the growth of Scotland, it has failed to keep pace with Glasgow, but is a much more beautiful city, and is richer in historical associations. Leith, its port, imports its foodstuffs, its grain for milling and distilling, and its esparto grass and wood-pulp for paper-making. The modern engineer has shortened the route from Edinburgh to the north by bridges over the estuaries of the Forth and Tay, and thereby lessened the importance of Stirling, and increased that of Leith and Dundee. Rosyth, on the north bank of the Forth, is an important naval base. *Dundee* (168), the largest manufacturing town of eastern Scotland, is built on the north bank of the Tay, at a narrowing of the estuary, far enough from the mouth to give shelter to ships. Trade with the North-Sea countries encouraged linen industries, and the failure to obtain Russian flax and hemp during the Crimean War led to the importation of jute from India, and the establishment of a thriving jute industry. Fishing, engineering, and fruit-preserving are other industries of Dundee. *Perth,* at the head of the Tay estuary, in the gap between the Ochils and the Sidlaws, commands the gate of the Highlands, where all the Tay routes converge. It was at one time the capital of Scotland, and is, to-day, an important railway and market centre. Its water, derived from sandstone, is very suitable for the bleaching, dyeing, and cleaning of fabrics, the chief industry of the town. *Stirling,* in the Forth gap, like Perth, was a strategic key to the Highlands, its castle, high-perched, dominating the gate. It is still important as a railway and market centre, and manufactures agricultural machinery and woollens.

(*d*) THE SOUTHERN UPLANDS.

South of the Midland Valley to the bordering Cheviot Hills the Southern Uplands run from south-west to north-east for a distance of about 120 miles, occupying almost all the country from sea to sea. They form a dissected plateau of old, hard rock, gritty or slaty in type, younger, lower, tamer, less fractured and folded than the Highlands. The wide, rounded moorlands, separated by V-shaped dales, exhibit heather-covered heights, peat bogs, grassy slopes, and wooded valleys. Steep crags and bare rocks are seldom seen. The north-eastern rampart of the region is formed by the Lammermuirs, the Moorfoot Hills, and the Haugshaw Hills. In the middle rise the Lowther Hills, with Broadlaw, Hartfell, and Queensberry Hill (over 2,600 ft). Farther to the south-west, Merrick, the highest point of the Uplands, attains a height of over 2,760 ft. On the southern side, the plateau gradually merges into the volcanic and granitic Cheviots, which rise to nearly 2,700 ft. in the peat mosses which cover the flattish dome of Cheviot. Lowlands are found along the coastal margins and in the river valleys. Three river systems drain the dome-shaped Uplands. The Tweed rising in the high middle region flows almost directly east to the North Sea. Its fertile "Merse" attracted the roving "Merse forayers"; and the scenery of its own and tributary valleys has been the theme of Scottish poets. The Clyde has its source also in the central hills. It cuts across the faulted boundary at right angles to proceed north-westwards over the Old Red Sandstone of the Rift Valley. The Solway rivers—the Dee, Nith, Annan, Liddel, and Esk—flow independently to the shallow "firth." Smoothness marks the coast-line, except where the Rhinns of Galloway and St. Abb's Head reach the sea.

Before the Union of England and Scotland the border country was the scene of constant warfare. The Cheviots with the Solway Moss on the west, and the Tweed lowlands on the east formed, and still forms, the boundary between the two countries. Of the three parts of the boundary the easiest to cross in olden days was the Tweed, for the Cheviots were difficult to negotiate, and the Moss was undrained. Herein lies the reason for the many important castles and battlefields on the eastern margin, and the few existing in the less vulnerable west.

Though possessing a larger proportion of low-lying cultivable land than the Highlands, the Southern Uplands are a thinly-peopled pastoral region, with crop-growing permanently successful only in the lower, drier valleys. The moorlands feed vast numbers of sheep, the counties of Berwick, Roxburgh, and Selkirk ranking high among the leading sheep-rearing areas in Britain. In the west, the pleasant pastoral dales and plains contain nearly all the people. The rearing of sheep, ponies, horses, and cattle, and the growing of oats and root crops are the chief concern of the farmers, and milk and cheese are sent to the populous Midland centres. On the small east coast lowland the drier and more extreme climate permits more agriculture. Oats, barley, root crops, potatoes, and some wheat are grown. Mineral wealth is almost lacking. The small coal-field of Sanquhar is worked, and the lead-mining north-east of Sanquhar has given rise to the village of Leadhills, the highest settlement in Britain. The granite areas of Criffel and Loch Doon send much granite to the industrial centres. Galashiels, Peebles, Hawick and Selkirk notably, and Jedburgh, Kelso, Coldstream, Greenlaw, Berwick, Melrose, Langholm, and Dumfries in minor degree, have tweed and hosiery industries, formerly dependent on local wool, pure water, and water-power, and now surviving by industrial inertia, the necessary coal, iron and machinery being obtained from the Midland valley, and much of the wool from Australia. Towns are few and small. The natural centres for the disposal of the local produce are the bridge towns—Wigtown, Newton Stewart, Kirkcudbright, Dumfries, Greenlaw, Duns, and Haddington. Route centres are Peebles, Selkirk, Hawick, Jedburgh, Melrose, Kelso, and Berwick. Dunbar, Jedburgh, and Dumfries are castle towns; while Melrose, Kelso and Jedburgh grew up round abbeys, whose present beautiful ruins attest their ancient splendour and the civilizing influence of the Church. Dunbar, Eyemouth, and Berwick are fishing ports, and Stranraer is the chief packet station for Ireland, the passage to Larne being only just over 40 miles. Dumfries, once an important border fortress, commands the south and west coast routes into Scotland, and the passes between Annandale and Clydesdale, and Nithsdale and Ayrdale. It is a river port, market town and railway junction, and has considerable woollen manufactures. Prestonpans yields salt for the curing of fish and for the chemical industries of the Midland valley.

Communications. The Uplands are a barrier between industrial England and the Central Lowlands. Routes across them are, therefore, of great importance. The "East-Coast Route" (North British section of the L.N.E.R.) is the easiest, for it crosses the Tweed, avoids the highlands of St. Abbs by bending inland along small valleys that meet in a fairly low pass, and proceeds along the narrow coastal plain, passing through Dunbar, where Cromwell gained a crowning victory, on its way to Edinburgh. This is the great historic road between England and Scotland. From Carlisle three main-line railways follow difficult routes across the plateau. The "Waverley Route" (North British), so called because it traverses the country immortalized by Sir Walter Scott, has the greatest obstacles to surmount, as it crosses the Uplands where they are cut into two by Tweeddale, and, consequently, must cross two watersheds. Leaving Carlisle the route proceeds to Langholm and ascends the valley of the Liddel to Hawick, reaching a height of nearly 1,000 ft. in the Riccarton tunnel, by which it reaches Teviotdale. From Teviotdale the line passes to the valley of the Tweed, and at Galashiels strikes along the valley of the Gala, and utilizes the pass at its head between the Moorfoots and the Lammermuirs to reach the east-coast plain and Edinburgh. The Caledonian (L.M. and S.R.) line, the shortest route between Carlisle and Glasgow, rounds the head of Solway Firth, mounts Annandale to near Moffat, climbs by an eight-mile long incline at 1 in 80 to the Beattock pass (over 1,000 ft.), and then has an easy run down Clydesdale. From Carstairs junction a branch line runs along the northern margins of the Pentlands to Edinburgh. The Glasgow and South-Western (L.M. and S.R.) route follows the Solway lowland to Dumfries, ascends Nithsdale to a pass at 700 ft. above the sea, reaches Kilmarnock in the Ayrshire lowlands, and, making a great curve to avoid the Lanark Hills, enters Glasgow. From Dumfries and Glasgow railways traverse the coastal plains to Stranraer.

ENGLAND AND WALES

> " A land of settled government,
> A land of just and old renown,
> Where Freedom slowly broadens down
> From precedent to precedent."
>
> —*Tennyson.*

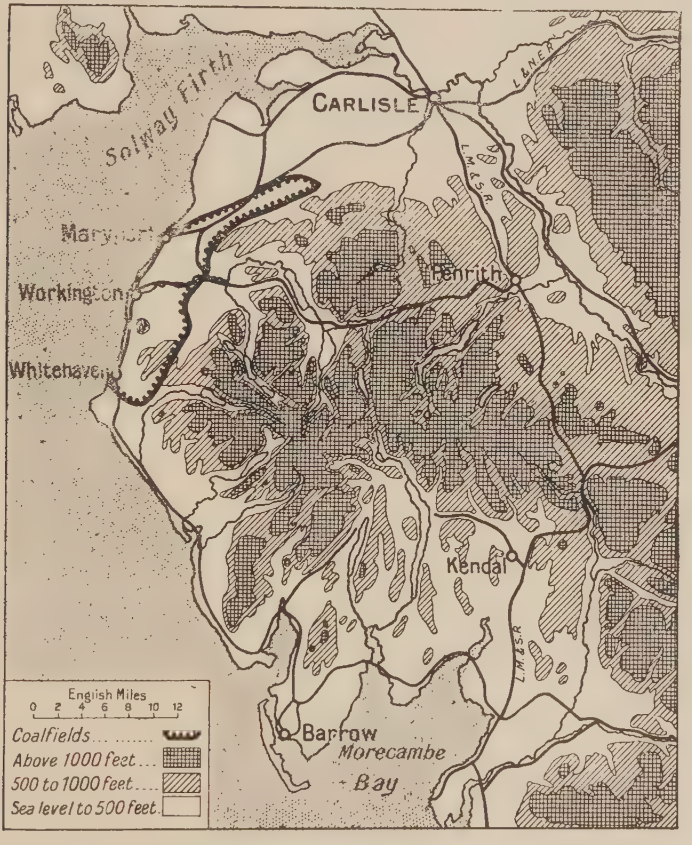
(*a*) NORTHERN ENGLAND.

The Pennine Chain. Southward from the Tyne gap to the Vale of Trent, a distance of 120 miles, the Pennine Chain (or, more correctly, the Pennine Plateau) strikes north and south. Its rocks consist of three series: first, and lowest, the mountain limestone, hard and grey; second, the later deposited coarse millstone grit; and third, the more recent deposits of sandstones, coal-seams, fire-clays and ironstones, with occasional thin limestones, known as the coal measures. The whole series, many thousand feet in vertical thickness, were laid down during long centuries in nearly horizontal strata. Subsequently, mighty forces, acting from east and west, caused the rock layers to form a great upfold. Denudation has removed the coal measures from a large part of the region, and even the carboniferous limestone has been exposed along parts of the axis, but important coal-fields still lie on the Pennine flanks at its four corners. Where millstone grit predominates as from Nelson and Keighley to the Peak tableland, the wild, barren, peat-covered moorlands are given over to sheep and grouse. Where the mountain limestone prevails, as in the northern Pennines and south of the

Peak, there is generally the charming karst scenery—deep dales, high scars and tors, waterfalls, caves, and underground streams. The Aire gap (under 500 ft.), due to the cutting back of the Aire and Wharfe on the east, and the Ribble and Wenning on the west, divides the Pennines into two parts, and forms the main route across them. North of the gap the Pennine Upland is higher, broader, and more massive than the southern region. Overlooking the Eden valley the great Pennine Fault forms a steep escarpment, crowned by Cross Fell (2,892 ft.) and other heights, at the base of which the South Tyne, the Wear, and the Tees flow to the North Sea. Between the valleys of the Lune and Ribble lie the Bowland Fells, drained by the Hodder and Wyre, a region thinly peopled, and avoided by railways. Woods, cornfields, and green quickset hedges are met with at the valley mouths ; short grass clothes the hillsides ; fields are fenced with stone ; and villages are absent, only scattered farmhouses built of local stone, weathered harmoniously to the tones of the sweeping slopes, giving proof of human habitation. On the bleak, broad, wind-swept tableland itself, peat bogs are common, but peat factories do not exist.

The southern Pennine region has well-developed coal-fields on both flanks, and is, probably, the most important industrial area in the world, its population numbering over 10,000,000. In the north, the high land extends westwards, forming the grit moors, known as the Rossendale Fells, which contain patches of coal measures, and much soft water, factors which largely account for the numerous bleach-works, dye-works, paper-mills and tanneries, located on their edges. The Irwell flows south from the Fells, and joins the Mersey, which, near its mouth, receives the Weaver from the Cheshire plain. In the south-east of this plain the Trent rises, and curves round the southern and eastern sides of the Pennines, following the red-marl belt to the Humber. The Dove and the Derby Derwent drain south through beautiful dales to the Trent. From the Swale to the Wharfe the streams have been captured by the Yorkshire Ouse, which developed along the soft formations of the Vale of York. This river is fed also by the Aire and Don. Thus, Ouse and Trent together pour into the drowned estuary of the Humber much of the Pennine waters.

The effects of the Pennines are interesting : they lie nearer to the west than the east coast, and, consequently, westward-flowing rivers are shorter and more rapid than those flowing eastwards; it acts as a condensing barrier to the moist Atlantic winds, and thus aids the cotton industry; its slopes provide good pasture for sheep, and helped to locate the Yorkshire woollen industry; its streams supplied early water-power, and, to-day, are an important source for drinking and dyeing purposes for the industrial centres of the north; its contained minerals are the base of the wealth of the industrial north; its disadvantage as a barrier separating two thickly-populated regions is largely overcome by the



THE LAKE DISTRICT.

gaps (notably the Tyne gap through which Hadrian's Roman Wall and a modern road and railway extend, and the well-utilized Aire gap); and its karst type of scenery and mineral springs in Derbyshire have caused the growth of such inland resorts as Buxton and Matlock.

The Lake District. The Cumbrian Group or English Lake District, a roughly oval mass, with valleys containing lakes diverging from a west to east axis, is connected by the granitic Shap depression (1,000 ft.) to the Pennines. It consists, essentially, of a central dome-shaped region of old sedimentary rocks, folded and faulted, varied with dissected masses of igneous rocks, frequently slaty in character. Partially surrounding the central mass is a girdle of carboniferous rocks, to which is connected another incomplete girdle of New Red Sandstone rocks. The mountains, residual in character, are highest near the centre; Scafell Pike (3,210 ft.), Scafell, Helvellyn, and Skiddaw, all attaining heights of over 3,000 ft. In the radiating glaciated and river-cut valleys beautiful lakes and streams are found. Windermere is the largest lake (about 10 miles in length), and Derwentwater and Bassenthwaite Water, the remaining portions of a single large lake partially filled by the alluvium brought down by the small streams, illustrate the formation of the small, fertile lake-plains, which will cause the eventual disappearance of the lakes. The wealth of glorious and varied scenery has always held a charm for writers, poets, and artists, many of whom have lived or spent much of their time in this district, drawing from it inspiration for their works and refreshment for their souls. There is scarcely a mile, which has not some literary association connected either with the "Lake School" of Wordsworth, Southey, and Coleridge, or with De Quincey and Ruskin, or with the paintings of Romney and Turner.

Yorkshire. Two isolated highland masses lie east of the Pennines. The first is the open heather-clad *Yorkshire Moors*, part of the oölitic limestone belt of England. Here trees are few, but the grassy valley bottoms form excellent grazing meadows. The second upland, the *Yorkshire Wolds*, is separated from the Moors by the rich Vale of Pickering, drained by the Derwent. The Wolds are part of the main chalk scarplands, in which breaches have formed the Wash and the Humber. They extend from the high cliffs of

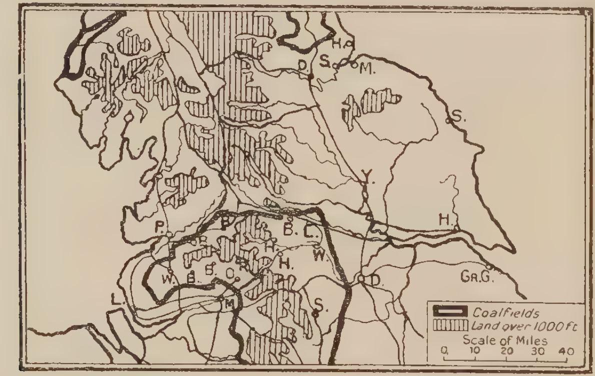
Flamborough Head to the Humber west of Hull, presenting steep faces to the Vale of Pickering and the Vale of York and gentle slopes to the south-east.

On three sides the southern Pennines are surrounded by broad plains, which reach the sea on the west, extend to the Moors and Wolds on the east, and to the limestone scarps on the south. These plains, composed of New Red Sandstone and covered in parts with fertile boulder-clay and alluvium, are among the richest arable and pasture lands of Britain. Narrow coastal plains, bordering the Cumbrian Mountains, broaden out into the extensive lowlands of the Solway and the Eden. On the east the Northumberland and Durham plains are narrow, but extend inland along the valleys of the Tyne and Wear, and widen towards the south. The rich, agricultural, heavily glaciated Vale of Pickering, is drained by the Derwent, which formerly flowed to the North Sea, but was dammed back by moraines and diverted to the Ouse. Holderness, the remaining Yorkshire lowland, lying south of the Wolds, is a low flat district, (no part exceeding 100 ft. in elevation) where the chalk is covered with glacial deposits, forming " heavy " soils in which wheat and potatoes are grown. Its southern termination is the low sand-spit of Spurn Point.

Lancashire and Cheshire Plains. Four coal-fields lie on the south-west, north-west, north-east, and south-east flanks of the Pennines. Each is a scene of strenuous industrialism and much specialization. The *south Lancashire and north-east Cheshire coal-field* is pre-eminently the cotton coal-field. The northern portion of the field lying around Blackburn and Burnley is separated by the grit moors of south Lancashire from the southern portion, which stretches from St. Helens in the west, past Wigan, Bolton, and Bury, to Stockport in the east. Cotton manufacture is the greatest and most complex of British industries, and is unique in its centralization. Ninety per cent of the cotton operatives of Great Britain are found in an irregular quadrilateral area of roughly 30 miles by 25 miles, enclosed in the main by lines through Preston, Leigh, Stockport, and Colne. Many factors have contributed to the genesis and development of the Lancashire cotton industry. Both in spinning and weaving an equable, humid climate is of great importance, as the fine filaments become more brittle and more liable to break if the relative humidity of the air is not high. Humidity is specially important in spinning the finest counts in which Lancashire excels. The prevailing westerlies, heavily laden with moisture, are compelled to ascend the western Pennine slopes, and cooling by expansion and ascension results in rain and humid air. Hence the southern exposed valley towns—Oldham, Bolton, Bury—where clay subsoils keep water on the surface and thus aid evaporation, are the spinning centres ; whilst the northern towns—Preston, Blackburn, Darwen—on drier plains or in sheltered valleys are the weaving centres. Other British areas, though suitable climatically, lack many of Lancashire's other advantages. The Yorkshire woollen industry early flowed into Lancashire, and grew under the less stringent Gild regulations, and when cotton was introduced skilled labour easily and eagerly utilized the vegetable fibre. Water supply, water-power, coal, ease of communication, the favourable location for American trade, the once sufficient supply of iron for machinery, the hereditary skill in textile manufactures and genius for invention of textile machinery by Lancashire workers, the energy and organizing power of Lancashire employers, and the sea-gate of the Mersey and the modern construction of the Manchester Ship Canal, have all played their part in Lancashire's pre-eminence. The natural advantages have been great and generations of workers have proved their worth. No other industrial area in the world shows such great specialization, nor so much of the good and the evil of the Industrial Revolution. The best Egyptian and Sea Island cottons are used in the Bolton and Manchester districts, while short-staple American and Indian cottons are spun in the Oldham, Rochdale, and Stockport areas. In the northern weaving area " Blackburn and East Lancashire towns largely produce fabrics for the Indian markets, such as shirting, jacconets, mulls, dhooties, etc. Preston is noted for its shirtings, sheetings, long cloths, and fancy cloths. Burnley produces printing cloths. Nelson and Colne make sateens and brocades. Radcliffe is largely engaged on weaving goods from dyed yarns, and Oldham is noted for fustians." (*Cd.* 9070.) Manchester, the natural centre of all the roads which cross the Pennine moors to reach the south-east of Lancashire, as well as of those that come across the detached parts of the moors, is the great market and exchange where the spinning-masters, weaving-masters, and finishers meet to buy and sell, and from whence the finished goods are distributed. Oldham is the biggest single centre of textile machinery; but Manchester, Bolton, Accrington, Bury, Blackburn, Burnley, and Heywood are also important. The bleaching, dyeing, printing and finishing branches of the cotton industry are obviously dependent on the chemical industries of St. Helens, Widnes, Runcorn, and Warrington (based on the salt of the Weaver valley), and also on plentiful supplies of pure water. Hence numerous works cluster round the edges of, and among the Rossendale Fells. It should be noted that all the raw cotton has to be imported; that about 80 per cent (value) of Lancashire's cotton manufactures are normally exported, of which India takes nearly 32 per cent, China 8 per cent, South America 8 per cent, and Europe 21 per cent; and that Lancashire probably clothes approximately one-third of the human race. Other industries connected with this coal-field are glass-making at St. Helens; woollen goods at Rochdale and Bury; iron-smelting at Wigan; silk goods at Macclesfield; felt hats at Denton and Hyde; paper at Darwen and Chorley; soap at Port Sunlight; and engineering of various types at Manchester—Salford.

LIVERPOOL (803) stands at the seaward end of the bottle-necked Mersey estuary, which is sheltered from all winds except the north-west. Less than two centuries ago it was a mere village, competing with Chester and Preston for the Irish trade. It owes its modern importance as the second port of Britain to the growth of the cotton industry and the great trade in foodstuffs and raw materials with the Americas. Its first dock was built 200 years ago; to-day, there are 9 miles of docks and 40 miles of quays. Though essentially the cotton port, it has virtually the whole of England as its hinterland; and its people are broader in their outlook than those of Manchester, whose dominant economic interest is cotton. As the "Home of Ship Owners" the city's interests are world-wide. To it come raw cotton from the southern States; grain from the North American prairies; rubber from South America; meat and metallic ores from North and South America; wool from Argentina, Australia, and South Africa; cattle from the western States; palm oil from West Africa; and tobacco and fruit from the southern States and the West Indies. From it go the cotton goods of Lancashire; the machinery and other metal manufactures of the Black Country, Lancashire, and Yorkshire; the woollens of Yorkshire; and the chemicals of Lancashire and Cheshire. Among its typical industries are flour-milling, the manufacture of tobacco, sugar-refining, and the making of marine engines. On the opposite left bank of the Mersey, where the little river Birket expands at its mouth into the wide and deep basin known as the Great Float, are the large shipbuilding and engineering works of Birkenhead.

MANCHESTER (731) with Salford (nearly 1,000), the cotton metropolis, is second only to London as the headquarters of industrial, commercial, and financial interests. It stands where the Pennines can be crossed along five valleys, at a point where a "hard rock of stone" on the banks of the Irwell made a good foundation for a Roman fort, between the Mersey marshes and the Pennine moors. Such a situation was bound to become a centre of trade when large populations centred in the valleys. The city's earliest importance lay in the manufacture of wool and flax, to which cotton was added in the fourteenth century, though the fabrics then made were of mixed material, and not of pure cotton. Pure cotton goods came with the Industrial Revolution, to which Manchester's growth is due. Though more important commercially than industrially, the city has, however, cotton and chemical manufactures, and very important engineering works. Its Ship Canal, completed in 1894, is capable of floating vessels of 12,000 tons, and has made it a seaport. In spite of the excellent accommodation of the port of



—The Yorkshire - Lancashire Industrial Region.—

Manchester and the very real economies effected by direct shipment to Manchester by the canal, less than one-fifth of the cotton used in the Lancashire industry is imported by Manchester, while over four-fifths is imported by Liverpool. Trade inertia is thus exemplified. When shipping-ring, ship-owner, and shipping-agent are persuaded that Manchester shipment is for their individual profit, the port of Manchester will become the greatest exporting and importing cotton centre.

The Cumberland Coal-field. The Cumberland field, one of the smallest of the English coal-fields, lies north of St. Bee's Head, close to the shore, and has galleries extending under the sea. Busy towns have arisen on it at Whitehaven, Maryport and Workington, the first two towns shipping the coal to the Furness and Belfast districts, the last-named utilizing it in the production of pig-iron. In the crescent-shaped rim of carboniferous limestone, of varying width, extending round the Lake District on the eastern side, from Askam and Millom on the south-west to Cleator Moor on the north-west, rich haematite iron ore is found in the veins and pockets of the limestone. This has given rise to the important iron-smelting industry of Barrow, Carnforth, Ulverston, Millom, Cleator Moor, Moss Bay, Workington, and Cockermouth. Barrow, in the Furness district of North Lancashire, has grown with great rapidity during the last seventy years, and is now one of the leading centres for the building of warships and the manufacture of ordnance. The local ore is supplemented by imported ore, especially that of Spain and Algeria.

The Northumberland and Durham Coal-field. Britain's oldest coal-field extends from near the middle part of the Tees valley northward across the Wear and Tyne valleys, ending a few miles to the north of Blyth. It lies close to the sea, and in Northumberland and the south the seams run under the sea. Almost all types of coal, except anthracite, are found, the northern portion yielding hard steam coal for steamships, while that of Durham is more largely of gas and coking coals. Much coal of various qualities is exported to the Baltic and Mediterranean ports, and to the south and east coast towns of England from Amble, Blyth, Dunstan, Newcastle, Gateshead, Wallsend, Jarrow, Shields, Sunderland, Seaham, and West Hartlepool; though the greater part of the output of the mines is used on or near the coal-field. Although very little iron is obtained in the immediate vicinity, ores are easily obtained from the neighbouring Cleveland district, Sweden, Norway, Labrador, Newfoundland, Spain, and Greece, and iron has become the leading industry. The most important branches of the iron and steel industries are shipbuilding and general engineering. In shipbuilding, the Tyne, the Wear, and the Tees (grouped as the North-Eastern shipbuilding district) maintain a rivalry with the Clyde. The chief yards are at Newcastle, Jarrow, Gateshead, Wallsend, North Shields, South Shields, Sunderland, the two Hartlepools, Stockton, and Middlesbrough. Less than 100 years ago there was scarcely a house on the site of Middlesbrough; but the discovery and utilization of the phosphoric iron ores of the Cleveland Hills, the invention of the Gilchrist Thomas process, the presence of magnesian limestone (used as a flux), the coke of the Wear valley, and the creation of a port into which ships of magnitude can enter, caused the birth and wonderful growth of a modern iron-smelting town of over 131,000 inhabitants. Darlington, an important railway junction (L. & N.E.R.), specializes in heavy steel work, and has railway shops. The presence of salt in the red sandstones between Hartlepool and the Tees gives prominence to the glass and chemical industries of Newcastle and Jarrow. Other industries are the mining and manufacture of zinc, lead, and copper in north and west Northumberland; the making of hemp and steel ropes for the large shipping business; and the production and export of grindstones from the millstone grit. *Newcastle* (275), the chief port and centre of the coal-field, lying 8 miles up the widened and deepened Tyne, stands at the meeting-place of land-roads from Scotland, London, and Carlisle, and sea-roads from everywhere. It is an ancient "bridge" port, and a modern manufacturing port and town, numbering among its industries shipbuilding, the manufactures of ordnance, machinery and chemicals, and the exportation of coal. *Durham*, an ancient cathedral city and university town, situated on a high rocky peninsula in a loop of the Wear, and, hence, better fitted for defence than commerce, has been outstripped by the industrial settlements.

The Yorkshire, Derby, and Nottingham Coal-field. From the Aire, about Bradford and Leeds, to within a few miles of the Trent at Nottingham, lies the greatest single exposed and concealed coal-field of Britain, supplying at present more coal than any other British coal-field. The carboniferous limestone yields abundant limestone and lime for various industries; the millstone grit, excellent building stone; the coal-measures, fine building stone, shale for brick-making, clay iron-stone, and blackband ore; and the sandstones abundant supplies of pure, soft water. Though the industries are varied, those of steel and wool are in the forefront. The valley of the Yorkshire Don has great iron and steel industries, with *Sheffield* (512) as the most important centre. Sheffield's grindstones and blades have been noted since the fourteenth century. Local iron ore, now supplemented with ore from other British districts, Sweden and Spain; plentiful coal to-day and wood in earlier days; the power from the Pennine streams before the age of steam; local limestone for flux; gannister for moulds and furnace floors; dolomite for lining the Bessemer converters; millstone grit for fine grindstones; and skill and divination of master and man; are the factors in Sheffield's wonderful progress. Its earliest important production was cutlery, and modern human factors have made it the centre of the science of Ferro-Metallurgy. Its manufactures include railway plant, cutlery, edge-tools of all kinds, boilers and steel-work for ships, armour-plates and guns, textile machinery, and silver and electro-plate. Weight of material is trivial compared with the labour spent on it. A few miles down the Don valley Rotherham is an iron centre, and Doncaster (L. & N.E.R.) and Derby (L.M. & S.R.) have large railway engineering works. In the Middle Ages the Flemish were the most skilful weavers in the world, and fortunately for England many were driven to English shores by the great floods in Flanders and were hospitably received by Henry II. Almost ideal conditions for the woollen industry existed in the West Riding of Yorkshire when the Flemings reached the north. The Pennine sheep supplied the wool; the excellent water supply furnished the means of cleansing and dyeing the wool; and the receptive minds in the north were quick to learn of these refugees the mysteries of their art. Water-power and abundant coal eventually led to concentration in the Aire and Calder valleys. The towns tend to specialize in particular kinds of work. Bradford, the largest woollen-manufacturing town in the world, is noted for worsted goods, mohair braids and velvet, and has great dye-works; Halifax specializes in carpets, baize, and light worsteds; Dewsbury and Batley make shoddy and blankets; Saltaire weaves alpaca; Huddersfield concentrates on broadcloth and dress materials; while Leeds manufactures more ready-made clothes than any other town in Britain. Textile machinery is made at Leeds, Bradford, Halifax, Huddersfield, and Keighley; Barnsley has linen and paper works; and an extension of the Lancashire cotton industry is found in Skipton, Halifax, Huddersfield, and Bradford. *Leeds* (506), the commercial capital and market for the finished products, stands where the Aire valley enters the Plain of York, on the easiest route through the Pennines to the west coast regions. Its modern university organizes scientific research which enables the manufacturers to improve the processes, and even to produce new substances, as in the case of the dye industry. Besides its industries already enumerated, it has important soap and leather works and oil refineries. It is necessary to note that the "muggy" air (though less damp than in the cotton spinning area of Lancashire) lodged in the Aire and Calder valleys is almost ideal for the various manufacturing processes, and that Hull, Grimsby, Goole, and Liverpool receive the raw wool imports from Australia, New Zealand, South Africa, Argentina, and India, and export the finished products. *Hull* (287), on the Humber estuary, the third port in England, has a hinterland population of perhaps 10,000,000. Its trade is of many kinds, but the chief import is oil-seeds, which are crushed in the city's great mills. Other imports are wheat, raw wool, pit props, meat, butter, dairy produce, flax, hemp, and sugar. Among its chief exports are iron goods, coal, woollens, cottons, silks, and leather goods. Much fish is landed on its quays, but it ranks second to Grimsby, which has the advantage of being nearer the sea and also nearer by rail to London. Immingham, especially equipped for the export of coal, and lying nearer the newly-worked concealed coal-field, threatens the coal trade of Hull. *Nottingham* (263), on the Trent, makes cotton, lace, and hosiery, although it lies in a comparatively dry region. The cotton threads used, however, are stronger and less liable to snap than those used in other branches of the industry.

The Vale of York, one of the most fertile, agricultural districts in the country, is about 40 miles broad in the south, and narrows to about 10 miles in the north, about Northallerton. The New Red Sandstone forms the foundation of the plain, but it is covered very largely with glacial deposits and alluvium, and mixed farming is the leading industry. Abbeys, monasteries, and cathedrals attest its early importance. *York*, built at a convenient crossing and bridging-place at the head of the tidal waters of the Ouse, is the chief agricultural and market centre. Under the Romans it was an important military station, and it was for centuries the second city in England. Its command of routes makes it an important railway junction and the centre of the military life of the north. Flour-milling and the making of cocoa and confectionery are its chief industries. Holderness and the Vale of Pickering are mixed farming regions.

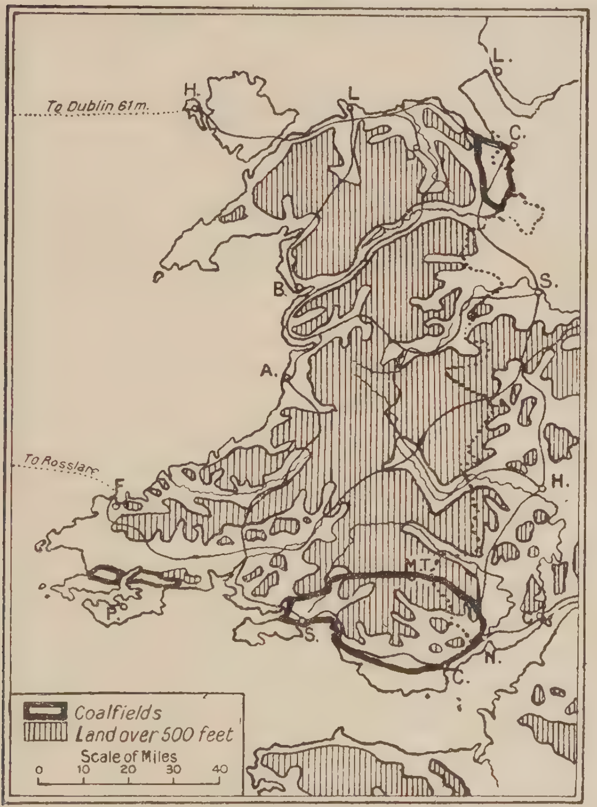
Communications. In northern England there exists a very close connection between the relief and the lines of communication. The modern railways follow the older roads, and they, in turn, the still older pack-horse routes. The "West Coast Routes" to Scotland are more difficult than is the "East Coast Route," and those from west to east encounter many difficulties. After crossing the Trent, the Midland (L.M. & S.R.) route enters the coal-field and continues along the eastern spurs of the Pennines through Chesterfield and Sheffield to Leeds. It utilizes next the Aire gap; climbs up the Ribble valley; tunnels through Blea Moor; and then keeps to the watershed between the Swale and Ure and Lune drainages. After negotiating Shap Fell it enters upper Edendale, and continues past Appleby to Carlisle, a very important railway junction. The North-Western (L.M. & S.R.) expresses cross the Mersey and the Ship Canal at Warrington, pass through industrial Lancashire to Preston, follow the plain, and keep quite close to the western edge of the Bowland Fells to Lancaster. They follow next the inner curve of Morecambe Bay; and, a little beyond Carnforth, begin the crossing of the Shap Fells; after which they proceed to Penrith and descend the Petterill Valley to Carlisle. The London and North-Eastern "East Coast Route" passes across the fenlands of the Ouse to Selby and thence to York; follows the Yorkshire plain northwards; and crosses the Tees before reaching Darlington. Reaching the coal-field it crosses the Wear; passes Durham; and continues through Gateshead and Newcastle to Alnwick. Finally, after striking the coast of north Northumberland, it reaches Berwick.

Important trans-Pennine routes are: a branch of the London and North-Eastern Railway from Newcastle through the Tyne gap and the valley of the South Tyne to Carlisle, by way of Hexham and Haltwhistle; the Lancashire and Yorkshire branch of the London, Midland and Scottish Railway from Manchester to Halifax, which passes from the Roch to the Calder valley by the Littleborough tunnel (1¾ miles); a branch of the London and North-Western (L.M. & S.R.), between Manchester, Huddersfield, and Leeds which uses the Tame, Colne, and Calder valleys and the Standedge tunnel (3 miles); the main-line of the Great Central (L. & N.E.R.) from Sheffield to Manchester, which traverses the Don valley and the Woodhead tunnel (3 miles); a branch of the Midland (L.M. & S.R.) from Derby to Chinley, Stockport, and Manchester, which passes through the Peak country, and the Cowburn (2 miles) and Totley (3½ miles) tunnels; and the northerly routes—one through Wensleydale which links Northallerton and Hawes, and the other along the Gretna valley from Barnard Castle and Bowes to Kirkby Stephen. Canals across the Pennines are: the Leeds and Liverpool Canal carried through the Aire gap; the narrow Huddersfield Canal which uses the Standedge tunnel; and the Rochdale Canal which climbs the Pennines by means of fifty-six locks.

The Isle of Man (230 square miles), lying in the Irish Sea almost equidistant from Ireland, Scotland, England and Wales, is closely comparable with the Lake district in structure. The northern part is a lowland of New Red sands, the south has limestone; and old slaty rocks occupy almost all the island from Ramsey westward by the mouth of Sulby Glen to the Calf of Man at the south-western end. Snaefell (2,034 ft.) is the highest point. The leading industries are fishing, centred at Peel, stock-rearing, agriculture (oats, the chief grain crop), slate-quarrying, mining for copper and zinc, and the manufacture of woollens. Perhaps, the chief resource of the island is the entertainment of summer visitors from industrial Britain, attracted by the lovely glens, health-giving climate, and holiday allurements. Douglas, Ramsey, Castletown and Peel, but especially Douglas, are the holiday headquarters. The island enjoys legislative independence; is governed by its own Parliament, the House of Keys; and the ancient open-air folk assembly still survives, meeting annually to hear new laws promulgated at Tynwald Hill.

b) WALES.

"All hail to the country where nature discloses
Her charms in each valley and heath-covered hill,
'Mid scenes where the spirit of beauty reposes
In dell, rock, and mountain, lake, river and rill."
—*Talhaiarn.*



WALES.

Relief and Climate. Wales, like the Southern Uplands, is a dissected plateau of old, hard rocks; but its misty moors and mountains, weird and awe-inspiring passes, beautiful lakes and tarns, foaming torrents, and its isolation, are reminiscent of the Scottish Highlands. The plateau is bordered on three sides by narrow coastal plains. The northern plain broadens across the sunken rift of Menai Strait into the low, worn-down island of Anglesey.

In the west the mountains approach the coast, and the Plain of Cardigan is thus made very narrow. The south coast plain is wide in Pembroke and the Plain of Gwent, but narrow in the centre. Snowdonia, the highest part of Wales, is composed of igneous rocks, and contains the mountain masses of Snowdon (3,560 ft.), Glyder Fawr, Carnedd David, Carnedd Llewellyn, and Moel Siabod. The N.E.-S.W. trend is exhibited in the Berwyn Mountains and the Arenigs, and in the valleys of the Towy, Teify, Upper Severn, and Dee. In Mid-Wales igneous rocks are practically absent, and the old slates, grits, and limestones are weathered into lower and less rugged hills. Old Red Sandstone forms the high Black Mountains and the Breconshire Beacons, and here the feature lines run west-east, South Wales thus being similar in build to southern Ireland and the Mendips. From Pontypool to Kidwelly, with a western extension from Carmarthen Bay to St. Bride's Bay, lies the oval coal basin of South Wales, one of the richest of British coal-fields.

The mountains of Wales " explain its isolation, and its love of independence ; they explain its internal divisions ; they have determined throughout its history, and what the direction and its method of progress were to be." (*Sir Owen Edwards.*) Wales provided at first a sanctuary and refuge for its inhabitants against Roman, Saxon, Danish, and Norman invaders, but, eventually, the ease of access along the northern and southern coastal plains and along the valleys opening eastward to the English plain facilitated the English conquest of Wales. The habitable lands lie around the edges of the plateau, and there is no central point on which the Welsh valleys and routes converge. Thus, a real union of Welsh tribes under one strong government was prevented, and Wales has never had a capital. Physical features, however, have helped the Welsh to be little affected by the newcomers of the " northern " race, so that they are distinctly shorter and darker than the English. The Welsh language has only been displaced where the English have settled in considerable numbers, as along the northern and southern coastal lowlands and in the valleys of the Severn and Wye. Elsewhere the Welsh retain their ancient language, manners and customs. Religious and political fervour, love of music, natural gift of eloquence, impetuous temperament, dislike of authority, assertive patriotism, fondness for flattery, and opportunism, are Celtic traits largely explained by ancestry, and the isolation, barrenness, beauty, and wildness of the Welsh hills. Like other barren mountain areas Wales exports her sons, many to the richer England and the Overseas Empire.

The height, barren nature, severe climate, and heavy rainfall of the larger proportion of the country limit farming to the lowlands and valleys. Farms are necessarily small. Oats are most widely grown, followed by barley, and far behind come wheat and potatoes. Much more important are the pastoral occupations. Cattle-rearing in the valleys and plains fosters a flourishing dairy industry, especially in Anglesey, Flint, Pembroke, and Carmarthen, which supply cheese, butter, milk and eggs to industrial Lancashire and the Midlands. Sturdy Welsh ponies are bred in the south, and large numbers of pigs are reared in Carnarvon, Montgomery, Denbigh, Brecon, and the dairy counties. Sheep-rearing is, however, the chief work of the farmers, and the central counties have far more sheep than any counties of England. Most of the Welsh mutton and wool come from the drier east. In summer the sheep pasture mainly on the mountains, but their winter quarters are on the lowlands, where root-crops and clover supplement the pastures. The home woollen industry of Carmarthen, Denbigh, Flint, Merioneth, and Cardigan, and the factory industry of Newtown, Holywell, Llandyssul, Llanidloes and other valley towns, which still survive by "industrial inertia," are obviously related to the local supplies of wool. Fishing is carried on round the coasts, principally for herring and mackerel.

Mineral Wealth. It is upon her mineral wealth, especially her rich deposits of coal, that modern Wales flourishes. *The South Wales Coal-field*, perhaps the most important in the world, extends over 1,000 square miles, in the counties of Glamorgan, Brecon, Carmarthen, Pembroke, and Monmouth. The main coal-field is enclosed within the curve formed by the River Usk on the north and east and by the lower Towy on the west, and is divided into three parts by the Taff and the Tawe. Many varieties of coal, some particularly valuable, are mined. West of Carmarthen the coal is pure anthracite; in the centre both smokeless steam coal and anthracite are found; and, in the east, bituminous coal for ordinary house and factory purposes is raised. As Welsh smokeless coal holds the field in international markets and anthracite is required in many places, there is a great export trade from Cardiff (with Barry), Newport and Swansea (with Port Talbot), the leading foreign customers being France, Italy, Egypt, and the Argentine. The rapidly flowing Usk, Taff, Tawe and Neath and their tributaries have cut narrow valleys, so deep that they have reached the seams of coal which lie below the general level of the plateau. Coal is, therefore, frequently got at by level " adits " as well as by the more expensive shafts. The railways nearly all run along the valleys, sometimes one on each side of the stream, and the task of the engines is made easier by the fact that the heavy loads of coal go downhill to the docks, while on the return uphill journey the trucks are either empty or loaded only with pit props. Overcrowding and cheerless conditions mark the life and work of the coal-field. The hillside outcrops are almost exhausted, and the pits are now in the valleys themselves, so that mines, chemical works, and towns are crowded into the valleys. The towns are usually only long rows of houses, placed close to the steep hillsides, where the sun never reaches them, and ground for gardens or space for recreation is absent. Iron-smelting was first naturally carried on where the iron ore was found on the north-eastern edge of the coal-field, and towns grew up at Merthyr Tydfil, Ebbw Vale, Sirhowy, Tredegar, Rhymney, and Dowlais. The almost complete exhaustion of the local ore, and the need of Spanish ore for steel-making, have caused blast furnaces to be built at Cardiff, Swansea, and Neath, and thus part of the iron and steel industry is now located in the coastal region. From the iron industry developed the tin-plate industry—the coating of steel sheets with tin—which is centred at Swansea, Llanelly, Port Talbot and Pontypool. Tin ore, formerly all obtained from Cornwall, is now almost wholly imported from the Straits Settlements, Nigeria, Bolivia, Spain, and Australia. Copper-smelting at Swansea dates from Elizabethan times. In the modern process acids are needed, and so chemical works have grown up in the district. Spelter-making, the refining of nickel, and the manufacture of copper sulphate and nickel salts (Mond Nickel Works), are other activities of Swansea. Engineering and machine-making, particularly for the railways, are carried on at Cardiff, Barry, Pontypool, Caerphilly, Newport, Neath, and Swansea; while ship repairing has developed at Cardiff, Newport, and Swansea. Cardiff, Barry, Swansea, and Newport, conveniently placed for the import of grain from Canada, India, and the Argentine, have enormous flour-mills. *Cardiff* (200), the capital of the old British kingdom of Gwent, the largest city in Wales, and the leading coal-exporting centre of the world, owes its predominance to the convergence of valleys, the steam-raising excellence of the coal of Glamorgan, the wise expenditure of locally-won wealth on fine docks and facilities for storage and transportation of goods, its direct touch with dense industrial populations, and the coal and iron of the coal-field which aid its coke-oven and chemical industries and the smelting of iron and copper. *Swansea* (158), the second port, at the mouth of the Tawe, where western valleys converge, is the great steel working, tinplate, oil-refining, and copper and nickel smelting centre. Lately, Swansea has become an oil centre. Upon the shores of Milford Haven are the old town of Pembroke, and the modern settlement of Milford, with its naval dockyard.

In North Wales is the younger *coal-field of Flint and Denbigh*, extending from Mostyn to Oswestry. Much of the coal is sent out of the district for household use or for making gas, but there is some manufacturing and engineering work carried on, especially by the River Dee. Lead and zinc ores are obtained in small quantities in the Halkyn hills, and they, with Cheshire salt, support the metal and chemical works of Wrexham, Ruabon, Shotton, Bagillt, Mold, and Flint. Local supplies of clay have led to the making of tiles and bricks, and the skilled population has attracted extensive artificial silk works, notably Courtaulds, Ltd., at Flint. Copper is mined in the Snowdon mass, and the energy of the rushing streams is converted into electric power, which is utilized in the electric furnaces of Dolgarrog for the production of aluminium. It is probable that more use will be made in the future of the water-power of north and central Wales. North Wales is Britain's chief source of slate supply, and large slate-quarries are worked at Bethesda, Penrhyn, Llanberis, and Festiniog. Bangor, Carnarvon, Port Penrhyn, Portmadoc, Port Dinorwic, and Tremadoc send the slates by rail or ship to all parts of Britain. A little gold is mined near Dolgelly, and some copper in Anglesey. There is much stone-quarrying for local use in all parts of Wales; but most valuable are the scythe-stones and chert of the north, and the igneous rocks of Penmaenmawr, quarried extensively for paving-setts and road metal.

The grandeur of the Welsh coast and the magnificent scenery of the Welsh hills bring holiday-makers from the big industrial centres of the Midlands and the north of England. Among the chief holiday centres are: Rhyl, Bettws-y-Coed, Llandudno, Bangor, Colwyn Bay, and Beaumaris in the north; Barmouth, Aberystwyth, and Aberayron on the west; and the inland spas of Builth Wells, Llandrindod Wells, Llanwrtyd Wells, and Llangammarch. The water supply of Liverpool is got from the Vyrnwy reservoir, made by damming the Vyrnwy valley, while that of Birmingham is derived from the Elan and Claerwen reservoir in the Wye valley.

Communications. The easy coastal routes on the north and south have been of great importance for centuries; a fact attested by their numerous castles. Chester commands the northern route, once used by Edward I, and now followed by the London, Midland and Scottish passenger and mail route to Holyhead, from which steamers ply to Kingstown, lying almost due west about 60 miles away. The south-coast route, controlled by Gloucester and Cardiff, is used by the Great Western Railway for its mail and passenger service to Rosslare viâ Fishguard. From Gloucester to Fishguard and Milford Haven the line keeps near the south coast, serving Newport, Cardiff, and Swansea on the way. Homeward-bound liners from America discharge passengers and mails at Fishguard, to secure quick transit to London viá the Severn tunnel. From Newport, a second Great Western main-line proceeds north, serving the towns of the Welsh Marches. It strikes northward by the lowland of Old Red Sandstone, through Abergavenny, Hereford, Leominster and Ludlow to Shrewsbury, and then over the New Red plain to Chester and Birkenhead. The earldoms of Chester, Shrewsbury, and Hereford were created to overawe Wales, and to control the valley routes of the Dee, Severn, and Wye leading to the rich English midland lowlands. Central and South Wales are reached by the London, Midland and Scottish route from Shrewsbury viâ Craven Arms, Llandrindod, Builth and Llandilo to Swansea and Carmarthen, which follows the N.E.-S.W. trend of the mountain chains, using tributary valleys of the Wye and the main valley of the Towy; and another route of the same group proceeds from Worcester through Malvern, Hereford, Hay, and Brecon to Swansea and Neath. A Great Western line from Shrewsbury follows the upper Severn, and passes through Welshpool and Montgomery. Leaving the main valley, the line follows that of a tributary, which leads it over a low watershed to the Dovey valley, where the line divides, one branch going viâ Aberdovey and the coast to the lower valley of the Mawddach, the other to Aberystwyth. The Cambrian branch of the Great Western passes through Wrexham and Ruabon, and then follows the upper Dee and Lake Bala to the Mawddach, past Dolgelly to Barmouth. Connection with the north-coast route is made by railways following the Conway and Clwyd valleys. Shrewsbury, an old British stronghold on a sandstone rock surrounded by a loop of the Severn, commanding the Severn valley and several cross-routes, although an English city, is most suited to be the capital city of Wales, for it is a more convenient meeting-place for Welshmen than any town in their own country.

(*c*) THE WELSH BORDER AND THE SEVERN BASIN.

The Cheshire Plain. Between the mountains of North Wales and the Peak mountains of Derbyshire lies the Cheshire Plain, composed of New Red Sandstone, largely covered by a fertile drift in the form of marl and alluvium. The plain is divided by a ridge of harder sandstone (over 300 ft. in height) into an east and west division, occupied by the Dee and the Weaver, respectively. Its rich soil, lee position with regard to the Welsh Highlands, lush grass, and nearness to large industrial centres, make it a dairying and agricultural region. Market gardens furnish fruit and vegetables, and Cheshire cheese is famed. The salt deposits of the Weaver valley are worked chiefly at Northwich and Winsford. Some of the salt is quarried, but usually water is pumped into borings, and then the brine is drawn off, and the salt obtained by evaporation. Consequently, collapsings and subsidences make the Cheshire salt towns uneven and irregular. The chemical and glass industries of the Mersey and Dee are largely due to the salt deposits. A little silk manufacturing is carried on at Macclesfield and Congleton, and cotton goods are made in the north-east coal area at Stalybridge, Hyde, and Stockport.

The Cheshire plain is of great importance in the geography and history of southern Britain, owing to the routes which cross it. It forms the natural route from London and the South to Scotland, North Wales, and Ireland (alternative to the Bristol route). The London, Midland and Scottish route for the north passes through Crewe, from whence the route to Holyhead proceeds north-westwards to Chester. At Crewe the main-line from London to Scotland meets branches from Bristol, Chester, Manchester and the Potteries. Since the middle of the nineteenth century, *Crewe* has grown from a small hamlet, called Oak Farm, to a town of 46,000 inhabitants. It contains the locomotive works of the line, and manufactures strong clothing. *Chester* (41), an ancient Roman stronghold, commanding the northern gate into Wales, and the route northward from the Midland plain, stands in a bend of the Dee, with its castle built on a sandstone rock above the river. Once one of the chief harbours on the west coast, the silting-up of the Dee estuary has taken away its trade, to the benefit of Liverpool and Bristol. Its Roman walls, its castle, and its cathedral indicate its past importance, and the six main and many minor lines which meet in its station bear witness to its modern importance as a railway junction.

Canals, linking the Mersey with the Trent and the Midlands, have been comparatively easy to construct on the Red Plain. The Birmingham Canal connects Birmingham and the Black Country towns with the estuary of the Mersey, and the Trent and Mersey Canal gives connection between the "Potteries" of Staffordshire and the salt works of Cheshire. Though only broad and deep enough for barge traffic, these canals are of great value in the transportation of coal, iron ore, kaolin, salt, and building stone.

The Severn. The Severn rises in the Plynlimmon group, not 20 miles from the Irish Sea, and follows the "Vale of Powis" to a little north of Welshpool, where it issues on the broader plain of North Shropshire. Turning its course to the south-east along the New Red Sandstone plains bordering the hill country, it enters its gorge between the Wrekin and Wenlock Edge, and then flows southwards, moving over red marls to its great estuary, across the vales of Worcester, Gloucester, and Berkeley. The lower Severn and the Warwick Avon valleys, cut out in the soft measures of the eastern limestone scarp, trend N.E.-S.W.; and it is thought that the Severn above Tewkesbury was once the main headstream of the Thames, and that the lowering of the valleys of the rivers flowing parallel to the Cotswolds brought about the separation of the upper Severn from the Thames and its capture and deflection to the Bristol Channel by the Warwick Avon and the lower Severn. It is probable that the upper Severn formerly emerged from the Welsh highlands to a plain which stood at the level of the summits of the Wrekin and Wenlock Edge, and that the Severn Gorge has been produced by the lowering of the plain to its present level.

Where the South Shropshire Hills come closest to the Pennines is the narrow gap, called the Midland Gate, which provides an outlet to the sea. *Shrewsbury* (31), the most important town on the upper Severn, is a natural fortress, built on a sandstone rock around which the river makes a loop. It is a county and market town, an important railway junction, and a great focus of roads from the upper Thames region, Birmingham, Crewe, and Wales.

At Bewdley, north of the confluence of the Stour, the Severn valley begins to open out into the broad plain of its middle course. In the narrow valley between the agricultural plain of Shrewsbury and the middle basin there are several small mining and industrial centres. The coal-field of Coalbrookdale, small and now almost exhausted, is famous for its china-ware. Ironbridge was so named because the Severn was here spanned by the first bridge made of iron, and beautiful Bridgnorth consists of a high market town under the protection of the castle which dominates the Severn gorge, and a low factory town where carpets are woven. The river Stour, a left-bank tributary coming from the high ground of the Black Country, affords an important route from that district to the Severn. Stourbridge (fire-clay bricks), and Kidderminster (" Brussels " carpets) lie on its course, and Stourport at its mouth. Hence, onwards, the Severn keeps on the New Red rocks, and as far as Gloucester the river is partly canalized and controlled by locks. Southwards, the Severn Ship Canal, cut between Gloucester and Sharpness to obviate the difficulties of the tidal bore, gives access to the Midland coal-fields for the timber, grain, and metal which arrive in the Bristol Channel, and an outlet to the iron of Staffordshire and the salt of Worcestershire. The Warwickshire Avon flows through the New Red plain to the Severn parallel with the limestone escarpment which overlooks its rich and pleasant agricultural and pastoral valley. Fruit and vegetables are grown in great quantities by intensive cultivation, the part called the Vale of Evesham, lying under the edge of the Cotswolds, being famous for its plums, apples, and pears, Only in the highest part of the valley is there an industrial development; here, Coventry, formerly noted for silk ribbons, now specializes in motor-cars and cycles, and artificial silk; and Rugby, a meeting-place of railway lines, almost in the centre of England, has electrical engineering works. *Worcester* (49), centrally placed in the plain of Worcester, stands near the confluence of the Severn and Teme, commanding the routes which follow the Teme and Warwick Avon valleys. Its fine cathedral is a witness to its long-continued prosperity. Porcelain of the finest quality and gloves are its chief manufactures. Droitwich, near it, obtains salt from the New Red layers, which plays an important part in glazing Worcester porcelain. Leamington on the upper Avon, Cheltenham at the foot of the Cotswolds, and Malvern at the base of the ancient rocks of the Malverns, with mineral springs and fine hotels, are attractive inland watering-places. Other towns of the Avon valley are: Stratford, the birthplace of Shakespeare; and Warwick, famous for its castle. *Gloucester* (51), at the lowest bridging point of the Severn, controlling the routes along the coastal plain of South Wales, very early became an important city. Its central position in a fertile area has made it both market town and county town, but tidal difficulties in the Severn estuary have checked its growth, its exports being insignificant owing to the high-priced articles of the Black Country seeking outlets at Liverpool, London, and Southampton. Even the railway carriages it makes for foreign railways are shipped from Newport, and the chief route to South Wales by the Severn tunnel between Pilning and Portskewett (4¾ miles) avoids the city. A great project has been brought forward for damming back the Severn at ebb tide, and controlling the outflow to create a great shipping basin above the dam, and utilize the water for the generation of electricity to supply industrial South Wales and the Midlands with sufficient cheap power and light. The line of the tunnel is roughly the line of the dam, and only the heavy capital outlay holds up the scheme.

The Wye is the most important right-bank tributary. It rises not far from the source of the Severn, and, after leaving the Welsh highlands, flows in a meandering course across the fertile undulating plain of Hereford, which is floored with soft deposits of Old Red Sandstone, formed in a basin lying between the steep Malverns and the hard rocks of the Welsh highland. The fertile and suitable soil encourages hop and fruit growing, cattle-rearing, and dairy farming. Hereford on the Wye, and Ludlow on the Teme, are typical border towns with many historical associations. Both are on the main north and south roads and railways which follow the Welsh border, and also command the east and west routes following the river valleys in which they stand. Their old buildings recall centuries of prosperous agriculture. In the southern part of Herefordshire and in Monmouthshire the Wye flows through one of the loveliest valleys in Britain, deeply cut in the hard limestone rocks of the Forest of Dean. The castle town of Monmouth lies to the north of this gorge, and Chepstow at the southern end where the coastal route along the Severn estuary crosses the Wye. The Forest of Dean plateau, still thinly covered with oak and beech, has beneath its surface coal deposits, but the amount obtained is small. Its small iron industry dates back to Roman times.

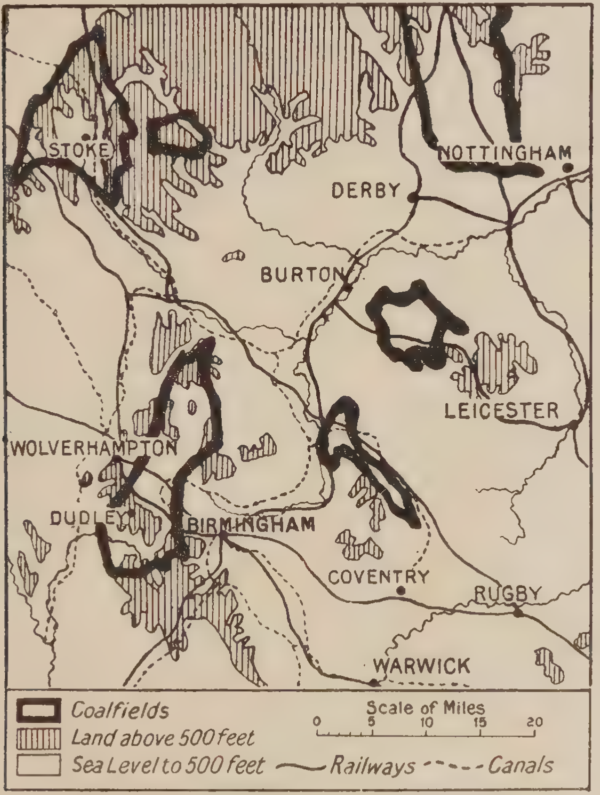
Several streams flowing to the Severn have cut deep valleys into the limestone escarpment of the Cotswolds. Stroud valley is the chief. Along it the Great Western Railway and the Severn-Thames Canal run fróm Gloucester viâ the Sapperton tunnel into the Thames basin. The sheep-rearing on the Cotswolds, the abundant pure water for cleaning and dyeing, the occurrence of fuller's earth, and the easy growth of teazles, all aid the West of England woollen manufacture. Broadcloths, waterproofs, Bedford "cords," and putties are chiefly manufactured. The region has lost much of its former importance, and obtains most of its wool from Australia through London and Southampton. Stroud, Frome, Bradford-on-Avon, Devizes, Wilton (carpets), Witney (blankets), Trowbridge, and Westbury are the chief centres.

The Bristol Avon has a somewhat curious course. It rises in the Cotswolds ; flows eastwards as a dip-slope stream ; then turns to the south past Chippenham along a narrow extension of the clay vale of the Scarplands, with the chalk downs on its eastern and south-eastern side. It next turns sharply towards the north-west past Bradford, and cuts transversely through the Cotswolds. Leaving the gap, it crosses the Bristol coal-field and passes Bristol itself, beyond which it cuts through the carboniferous limestone, making the fine Clifton gorge, and, opening out, joins the Severn at Avonmouth. Probably the river first cut its way backwards through the gorge south of the Cotswolds, and then developed a lateral tributary along the soft clay, which captured and deflected to itself a former tributary of the Thames. *Bath* (69) stands where the Avon crossing could be best defended against an enemy approaching from the west. It is a residential city with mineral springs known to the Romans, and is connected with former celebrities of fashion. *Bristol* (377) was the "Bricg-stow," or bridge-place, marking the limit of navigation for ships in mediaeval times. Its early trade was with Ireland, but this was extended by the great discoveries of the fifteenth and sixteenth centuries to the West Indies and the Americas. The hinterland of the port is not large; but the ease of access to London and the Midlands, the fact that it is nearer to America than either Liverpool or Southampton, the coal of the Bristol coal-field, and the construction of large docks at Avonmouth and Portishead to accommodate large vessels, help Bristol's expansion. In recent times the decrease in the imports of West Indian sugar has caused Bristol to develop its trade in cacao, tobacco, and fruit, especially in bananas and oranges. The refining of sugar, the manufacture of cocoa and chocolate, the preparation of tobacco, and engineering, are its chief industries. Two canals, the Kennet and Avon and the Wilts and Berks, now almost derelict, pass south and north of the Marlborough Hills respectively, and connect the Avon with the Thames.

(*d*) THE MIDLANDS AND THE BASIN OF THE TRENT.

The Midland Plain. The great triangular Red Plain of the Midlands, and its northern extension on both flanks of the Pennines, are chiefly built of New Red Sandstone and of red marl, which give considerable character to the region—red earth, red buildings, and red rocks. There are, however, many places covered with boulder clay and other glacial deposits, together with alluvial deposits along the courses of the main rivers. Openness and ease of communication characterize the plain, though the coal measures protrude in low humps forming the high ground whence flows the drainage to the Trent, Mersey, Dee, and Severn estuaries. In Charnwood

Forest, the Clent Hills, and Cannock Chase the Midlands rise above 500 ft. On the south-east of the Pennine Upfold there is the Derby and Nottingham portion of the great coal-field, reaching almost to the Trent. On the south-west appears the North Staffordshire coal-field, embracing the Potteries. Further south the coal measures dip below the New Red layers, but bulge up through these to form three detached coal-fields—the Ashby-de-la-Zouch between the Trent and Leicester, the Warwickshire between Tamworth and Nuneaton, and the important South Staffordshire extending from Cannock Chase through the Black Country. Farther west in Shropshire, the coal



The Midlands.

rocks are bent up against the older rocks of Wales. Between all these outcrops the coal is preserved underneath the newer deposits, and is mined wherever the depth is not too great. The coal measures formerly yielded iron ore, but little is now obtained from any except those of Staffordshire. Rarely now are coal and iron obtained from the same formation. Broadly speaking, the Midlands consist of fertile, broad, and monotonous plains, devoted to agriculture, and low uplands on, or near which, manufactures have developed.

The Trent has its origin in the high ground on the borders of Cheshire and Staffordshire. It curves round the southern and eastern sides of the Pennines, following the red marl belt until it reaches the Humber, the combined drowned estuary of the Ouse and itself. Its swiftly flowing strike-tributaries on its left bank are the Dove and Derwent from the Pennines; whilst sluggish right-bank tributaries flow to it from the low limestone hills of the oölitic belt. It is thought that the course of the Witham through the Lincoln gap to the Wash was once the lower course of the Trent.

Throughout the lowlands, and especially on the alluvial meadows, cattle-rearing is important. The milk supplies the needs of the industrial population, and the hides are tanned into boots and shoes. Much wheat, and enormous quantities of potatoes and root-crops are produced on the alluvial lower course of the Trent, which is favoured with a comparatively dry climate. The wealth of the Midlands, however, lies largely in its manufactures. It is the densely-packed industrial home of small things, of the numerous little articles that go to make up the luxuries of primitive peoples and the necessities of those more civilized. The distance from the sea affects the cost of carriage both of the raw materials and the manufactured product, and the goods made are, therefore, such as require a maximum of skill together with a minimum of material. The main industry of the North Staffordshire coal-field is the manufacture of pottery, which owed its origin to the presence of local deposits of clay and coal, and its development to the utilization of china-clay and the genius of Wedgewood and Flaxman. Only the saggars, in which the china is baked, and the coarser kinds of earthenware are now made from local clays. For the finest china and porcelain the Potteries import the china-clay of Devon and

Cornwall, and the pipe-clays of Poole viâ the Mersey-Trent Canal; while gypsum from the red marl of Chellaston, near Derby, chert from the limestones of the Peak and Flintshire, flints from the chalk downs, and salt (for glaze) from Cheshire, are also used as ingredients. The original five pottery-making towns—Tunstall, Burslem, Hanley, Stoke, and Longton—with Newcastle-under-Lyme, united a few years ago and took the name of *Stoke-on-Trent* (241). Quite recently Stoke has been raised to the rank of a city. *Stafford* (29) lies in the "Midland Gap" in rich pasture country. It is, therefore, an important railway centre, and manufactures boots and shoes.

South Staffordshire Coal-field. The South Staffordshire coal-field supplies power to one of the busiest regions in England. The local clayband ores, easy to smelt, originally located the iron-working and hardware industries, but now they need large supplements of the ores of the limestone escarpment to the east, and of those from Spain. Iron manufacturing began here long before coal was used, and, as in the Weald, iron used to be smelted with charcoal from the neighbouring forests. Little timber is now left, but its former abundance is indicated by such place-names as the Forest of Arden, Charnwood Forest, and Cannock Chase (forest). The area is small; the towns closely packed together; and its once picturesque, well-wooded, hill scenery has been disfigured. Mackinder thus describes the Black Country: "The whole district is one great workshop, both above ground and below. All night it is lurid with the flames of the iron furnaces, by day it appears one vast, loosely knit town of humble homes, amid cinder-heaps and fields, stripped of vegetation by smoke and fumes." *Birmingham* (919), the commercial, industrial and intellectual capital of the Midlands, lies some miles off the actual coal-field, roughly at the point of junction of the threefold division of the Central Plain. Canals and railways lessen the disadvantages of its inland position, and its concentration on small valuable metal articles tends also to its advantage. It draws to itself the resources of the industrial region to the north, the agricultural districts to the south, and the Severn valley region and Welsh Marches to the west. It supplies their multitudinous wants, serves their interests, and centres their thoughts. Its industries are varied, but it specializes more particularly in small metal goods of all kinds—steel pens, swords, guns, bedsteads, jewellery, buttons, medals, brasswork, and the standardized parts of bicycles and motor-cars. In many of the surrounding towns there is even greater specialization than in Birmingham itself. Redditch is noted for pins and needles; Dudley for nails and chains; Walsall for harness and saddlery; Wolverhampton for locks and keys; Wednesbury for stoves, cisterns and bedsteads; and West Bromwich for brasswork and small arms. The Warwickshire coal-field supplies *Coventry* (128) with coal. This very old town, once famous for silk and more recently for watches and bicycles, has now large motor-manufacturing and artificial silk works, which have caused its population to increase by over 80 per cent in the last twenty-five years.

Leicestershire Coal-field. The Leicestershire coal-field is mainly a mining area, but Ashby is still a market town in an agricultural district, as it was before the coal was mined. *Leicester* (234), some miles distant from the coal-field, has manufactures of woollen hosiery, cotton lace, boots and shoes, and agricultural machinery. Coal from the neighbouring coal-field, wool from the sheep of the oolitic heights, and hides from the cattle of the rich pastures of the Trent and Soar lowlands, localized its industries, and imported wool and hides now aid their development. *Burton*, a great brewery centre, lying north of the coal-field, gets its coal (anthracite) from South Wales. The gypsum in solution in the Trent waters, and the growth of barley in the Trent valley, favour its industry. The Stilton cheeses and the pork pies of Melton Mowbray still emphasize the importance of the Leicester dairy industry. Charnwood Forest, a rugged mass of igneous rocks, lying between Leicester and the coal-field, has been described as "a bit of Wales within the English lowlands." By damming up its narrow gorges, reservoirs have been formed in the wider parts to supply Leicester with water. Its chief value is in its granite quarries.

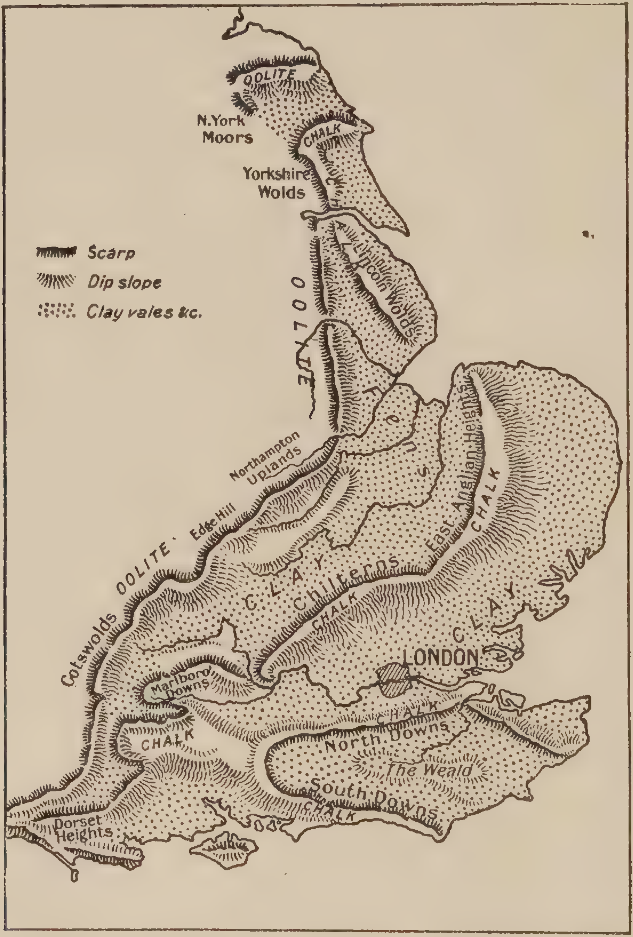
Derby (130) stands where the Derwent emerges on to the plain. Once an important strategic point owing to its command of the Derwent valley, it has become a great railway junction, and the site of great locomotive- and carriage-building works. It has also porcelain, textile, and silk industries. *Nottingham* (263), once surrounded by forests, stands on the New Red Sandstone at a place where a high, precipitous, castle-crowned rock commands a view over the Trent valley. It specializes in cotton hosiery and lace, and leather goods. Newark and Gainsborough are the chief market centres of the lower vale of Trent. The former is an old castle town, the latter makes agricultural implements. Near Gainsborough the " eagre " of the Trent may be seen, and between the town and the Humber, the land adjoining the river is very low and marshy, resembling the Fens and the marshes of the Lincolnshire coast.

Communications. The three main gates to the Midlands are the Midland Gate to the Lancashire-Cheshire plain, the Trent valley to the Humber and the Vale of York, and the Severn valleys, leading to South Wales, and through small gaps across the Cotswolds to the Thames basin. Low passes and low land encouraged the network of canals from Humber, Mersey, Thames, and Severn which intersect and develop in the Midland area. Four main railway routes run across the region. The London and North-Western (L.M. & S.R.) line enters the plain at Rugby, and passes to Nuneaton, Stafford, and Crewe, and by a branch line to Coventry, Birmingham, and Shrewsbury. The Midland line reaches the Red Plain at Leicester, and runs across the narrowest part of the plain to Nottingham and Derby. Rugby, Leicester, and Nottingham are on the Great Central (L. & N.E.R.) main line ; and the Great Western serves Birmingham, Shrewsbury, and Birkenhead. Important transverse lines join the main routes and towns. It is interesting to note that the Midland route to Bristol and Gloucester down the steep slope to the Severn valley contains the Lickey incline of three miles at 1 in 37.

(*e*) THE SCARPLANDS AND PLAINS OF SOUTH-EASTERN ENGLAND.

A striking feature of south-eastern England is the grained structure of the country south-east of an irregular line from Middlesbrough to Weymouth. A long, curved, but broken line of hills, rarely above 1,000 ft., extends from Portland Island to the North York moors. The hills are composed of oölitic limestone, and run from N.N.E. to S.S.W., embracing the Cotswolds, Edge Hill, the Northampton Uplands, the Lincoln Edge, and the Yorkshire moors.

In Lincolnshire the ridge is lowest (only about 200 ft.); it is highest where it forms the Cotswolds, Cleveland Hills and North York



THE SCARPLANDS.

moors; and disappears between the Lincoln Edge and the Yorkshire moors. The oölitic measures dip eastward, first below vales of clay and other soft layers, and then below a great sheet of chalk, which forms the broad London basin, largely filled with sands and clays. Both the limestone and the younger chalk measures end in an abrupt face or escarpment, whilst their other face, the dip slope, is gentle. There is no doubt that these measures once extended much farther west and that they have been eaten back by weathering and stream action, which has also lowered the level of the vales of soft layers separating all the belts of more resistant rock.

In the south-east corner the North and South Downs were formerly united by a great arch of chalk which has been worn away, thus exposing the older measures of the Weald. South of Salisbury Plain (plateau) lies the Hampshire basin in a shallow downfold of the chalk, covered with recent deposits of sand, gravel, clay, and freshwater limestone. The chalk reappears in the centre and south of the Isle of Wight. Roughly parallel to the oölitic heights, in crescent-shaped line, from Flamborough Head to the White Horse Hills, stretch chalk ridges with escarpments facing the Midlands and gentle dip slopes to the south-east. They include the Marlborough Downs, the Chiltern Hills, the East Anglian Heights, the Norfolk Edge, the Lincoln Wolds, and the Yorkshire Wolds. In several places the ridge is breached, but most notably by the Wash and the Humber. East of the Salisbury Upland the chalk is continued as the Hampshire Downs, which split into two lines of hills, known as the North and South Downs. These hills have steep escarpments looking inwards to the Weald, and run roughly eastwards, terminating seawards in the cliffs of Dover and Beachy Head respectively. The Western Wessex Downs or Dorset Heights lie south of the Thames and the Vale of Newbury.

Though the scarplands and lowlands include much less than half of the area of England and Wales, they contain over three-fifths of the arable land. Agriculture is the leading occupation of the plains and sheep-rearing of the hills. Industrial centres, apart from London and the ports, are largely absent, and London still dominates the region. Essentially agricultural in outlook, lying open to invasion, and easier to develop than the northern lands, this region has played a great part in English history and culture.

The Basin of the Wash. The seaward edge of the Fens is the Wash, a wide, shallow inlet formed by the invasion of the North Sea through a great breach in the chalk. Described as " the delta of the rivers of the West," the Fens owe more to the fine silt which has been swept inland by tidal currents. Stretching from Lincoln to Cambridge, and from Peterborough to Brandon, in Norfolk, they cover more than 1,300 square miles, their length being 75 miles, their breadth 35 miles. Topographically, the Fens are one vast plain, drained by the sluggish and meandering longitudinal Witham, Welland, Nene, and Great Ouse. In character the region is very similar to Holland. Its artificial drainage canals, such as the famous Bedford Levels, the canalization of the rivers, the windmills, the embankments, and the pastures, all have a Dutch appearance ; and the intensive market gardening, the reclamation of the land, the culture of bulbs, and the field workers of both sexes increase the likeness. Bits of older strata, hard and firm, stand up like islands in this land of morasses, and as " islands " they have been famous in English history. The Wash is diminishing in size owing to the deposition of the silt brought down by the rivers, and to the dumping of sand and other materials produced by coastal erosion and swept along by the tides. Unlike the other rivers which rise in the oölitic escarpment and flow to the Wash, the Witham rises on the western slope, and reaches the clay vale only after passing through the Lincoln gap which it has cut in the Lincoln Edge.

Agriculture is the leading occupation, and this is to a great extent intensive ; but it is not the intensive agriculture of seasonal rhythm. Rather is it intensive in the maximum amount of labour put by small proprietors into their holdings, spade and hoe culture being common in the market gardening and fruit-growing districts. Large crops of wheat, barley, and potatoes, together with miscellaneous crops of poppies (for opium), woad, mustard, flax, fruit, and flowers are grown. Pastoral occupations are important, though cattle and sheep are not reared in very large numbers. The absence of coal limits manufactures to those connected with agriculture and pastoral pursuits. Thus, agricultural implements are made at Peterborough, Bedford, Lincoln, March, Huntingdon, and St. Ives ; whilst boots and shoes are made at Northampton, Kettering, Wellingborough, and Higham Ferrers.

Ports. Small fishing ports have arisen in the Fenland at or near the mouths of the rivers ; sometimes they carry on seaward trade, but the difficulties of navigation amid the shoals of the Wash, restrict shipping to small vessels. King's Lynn, near the mouth of the Great Ouse, a once-important port, has retained some seaward trade, but it is more important as a stock-market than a port. Spalding, on the Welland, has quite lost its maritime associations, and is now a market and agricultural centre largely engaged in fruit culture and market gardening. The same may be said about Wisbech on the Nene, and Boston on the Witham, except that they have retained a little sea-borne trade. Outside the basin of the Wash, but serving its interests, *Grimsby* (82) stands on the Humber, near its mouth, excellently placed for fish traffic. It is the seventh British port in volume of trade, and the leading fishing port. Together with its twin port, Immingham, it owes more to the artificial stimulus of docks and railways than to geographical situation. The older port carries on the bulk of the fish and timber trade, while the revived port of Immingham has taken over much of the export of coal and goods from Lancashire and Yorkshire.

TOWNS. Three leading types of town sites are found. Cambridge, Bury St. Edmunds, Bedford, Huntingdon, and Peterborough stand on the Fen margin, on raised, and, therefore, drier ground. Within the Fens the earliest settlements grew up on low gravel hills (" islands "). Such are the cathedral city of Ely (the refuge of Hereward the Wake), March, and Spalding. The third set of towns lies along the coast. Before the Fens were drained they provided a serious obstacle to communications. In Roman times the great road from London to Lincoln skirted their western margin, and passed through Cambridge, Huntingdon, and Peterborough. To-day, the Great Northern (L. & N.E.R.) Railway from London, the Midland (L.M. & S.R.) from Nottingham, the Great Northern (L. & N.E.R.) and the Great Eastern (L. & N.E.R.) Railway from Doncaster to Cambridge, and the Great Central (L. & N.E.R.) Railway line to Grimsby and Immingham Docks, pass through the Lincoln Gap. *Cambridge* (59), on the Cam, had water nodality in the past, and present land nodality has made it a market town and railway centre. Its fair (Stourbridge), in the Middle Ages, had European repute, but its modern prosperity is based on its well-endowed university rather than on the fact that it is the focus of a productive agricultural district. Peterborough, a cathedral city, on the Nene, manufactures agricultural implements and bricks, and is an important market for wheat. *Lincoln* (66), cathedral city, and important route-control centre since Roman days, on the old Roman road through the Lincoln gap, was once a river port and wool-collecting and exporting centre. To-day, it is a market town noted for its horse and cattle fairs, and its importance has been increased by the railways and the manufacture of agricultural implements. Bedford, on the Ouse, with manufactures of straw hats and agricultural machinery, and Kettering with boot and shoe factories, are on the main Midland (L.M. & S.R.) line. *Northampton* (91), on the Nene, the leading British town of the boot and shoe and tanning industry, is favoured with local supplies of hides and tanning material, though dependence now is mainly on foreign supplies. The numerous cathedrals and monasteries of the Fens give proof of its agricultural wealth, and its lofty, handsome spires, uplifting the soul, furnish landmarks through the monotonous land.

East Anglia. East Anglia lies east of the chalk ridges of the East Anglian and Norfolk heights, and includes the greater part of the counties of Norfolk, Suffolk, and Essex. It forms the northern portion of the London basin, and much of it is covered thickly with boulder clay, left by the retreating glaciers of the Ice Age. The whole area is undulating ground, rarely rising over 200 ft. above the sea, and nowhere reaching 400 ft. except just on the borders of Cambridgeshire. A fairly level expanse of sands and clays lies between the chalk country and the low and marshy coastal districts. The region is drained by the small rivers—Bure, Yare, Waveney, Stour, Colne, Chelmer and Crouch, the watersheds between which are mostly low and ill-defined. Until the last few centuries the clay-lands were densely forested, and remnants are still preserved as pleasure woods for Londoners in Epping and Hainault Forests. Isolated by forest, fen, and swamp, ill-protected and easy of access from the sea, this region was early entered by Saxon and Danish invaders, who here developed that distinctive individuality, which has made their descendants pioneers in religious and political movements.

The coastline is remarkable for the rapid erosion of its cliffs of soft gravel and clays, and the removal southward by tides and currents of the débris, which in certain places has been deposited in the form of shingle-spits and sand-spits as at Lowestoft Ness and the mouth of the Alde. In Roman times the Bure, Yare, Wensum, and Waveney emptied into a wide estuary, but this became so silted up and barred by sand-spits that portions of it were converted into the wide, shallow, reedy lakes known as the Norfolk Broads. Silting is gradually reducing the Broads. Their only economic importance now lies in the joy they give to the holiday-maker, the angler, and the boating enthusiast.

AGRICULTURE. East Anglia is an almost purely agricultural district. The soil is rich; the climate is hot and dry enough in summer to ripen corn, and cold enough in winter to assist in breaking up the fertile soil, and the period of summer sunshine is comparatively great; and improved methods of cultivation, discovered on the Continent, were first tried here. The old three-field system was early replaced by the Norfolk four-year rotation of crops, with the result that this region became the richest, densest, and most cultured part of Britain in the Middle Ages. The heavier soils yield large crops of wheat, the lighter soils barley and oats; whilst root crops, such as potatoes, turnips, mangolds, peas, and beans, are grown in turn with the corn upon the same land, and are used as the winter food of the animals. The marshy districts near the coast are largely grasslands used for summer grazing. There are many fruit farms where berry-fruits and plums are grown for the London market and for jam. *Yarmouth* (61) and *Lowestoft* (44), great fishing centres, owe their development to their close contact with the rich fishing grounds of the North Sea. Both are noted for the enormous number of herrings landed there every year. The curing, smoking, packing and dispatching of these employ large numbers of the inhabitants and imported labour from Scotland. Yarmouth Roads, protected by large sandbanks some four miles out to sea, which have been formed from the waste of the coast, are the only secure anchorage between London and the Humber. All along the coast there are seaside resorts—Southend, Clacton, Lowestoft, Yarmouth, Gorleston, Felixstowe, Cromer ("Poppy-land"), Sheringham and Hunstanton. Orwell and Stour unite to form Harwich harbour, a naval base and modern packet station with important continental connections with the Hook of Holland, Hamburg, Antwerp, Flushing, and Esbjerg, and a train-ferry service with Zeebrugge.

Norwich (121) and *Ipswich* (79), the two largest towns of East Anglia, are both associated with river estuaries and a bygone sea trade. Norwich is a castle town and cathedral city, retaining still some of its old importance in the manufacture of wool. It also manufactures boots and shoes, agricultural machinery, starch, mustard, and silk. Ipswich, at the lowest bridge over the Orwell, is an important wheat market, and the chief junction of the Great Eastern (L. & N.E.R.) Railway. It manufactures agricultural implements, flour, boots, and clothing. Thetford makes traction engines; Stowmarket explosives; and Sudbury and Braintree silks. Colchester and Chelmsford are built on dry sands and gravels above the boulder clay, where copious supplies of good water are assured. Both are market centres. The former is also a military centre, and is noted for its oysters which are dredged from the rich estuarine oyster-beds between Colchester and Maldon.

The Basin of the Thames. The Thames, the chief river in the British Isles, rises in the oölitic Cotswolds, and flows eastwards to the North Sea. Its basin falls into two main divisions: the upper basin between the oolite and the chalk as far as the Goring gap, with Oxford as its centre; and the lower, or London basin (including much of East Anglia), between the chalk and the sea, with London as its focus. The clay vales of the upper basin formerly stood at the same level as the top of the chalk. When the basin was lowered the river began to cut, and, later, to deepen the gap between the chalk of the Marlborough Downs and the Chilterns, known as the Thames or Goring Gap. Similarly, the Wey, Mole, Darent, and Medway from the Wealden basin have cut gaps in the North Downs. The tributaries of the upper basin—Cherwell, Evenlode, Windrush, Colne, and Thames—flow from the Cotswold ridge along the dip slope as consequent streams, and, after uniting, are joined by the subsequent Thame, flowing more or less parallel with the western steep edge of the Chilterns. The synclinal fold of the London basin is filled with measures of three main kinds. Immediately above the chalk are pebbly beds of marine sands, which appear at the surface along the fringes of the basin, and are known as the Woolwich and Reading beds. On the top of these sands lies the great cap of London clay, a marine bluish clay, weathering to brown. Uppermost are the younger Bagshot sands, which give rise to gorse and fir-covered dry tracts, very different from the marshy moist stretches of London clay. The Aldershot area is in Bagshot sands, and Hampstead Heath owes its character to these beds. Throughout the greater part of its course the Thames forms a county boundary. This is probably due to the fact that the lower Thames region, formerly either forest or marsh, was easily settled by invaders from the sea, who approached the river from the north-east and south, because the river entry was barred by the strong fortress of London.

The limestone and chalk ridges support sheep, famous for their wool; and the presence of clear running water for cleansing and cheap power led to the establishment of flourishing cloth industries at such centres as Chipping Norton and Northleach, which have long since decayed. Witney, in Oxfordshire, however, continues to manufacture blankets. The old glove industry still survives in Charlbury, Chipping Norton, and Woodstock. Excellent building stone is quarried in the Cotswolds, and is largely used in the towns and villages of the slopes and valleys. The beech trees covering the lower slopes of the Chilterns are used in the chair-making and furniture industries of High Wycombe and Wendover; and local brick-earths make brick-making a common industry in the Thames valley. From Aldershot to Woking the infertile heathlands are of little economic value, hence their use as a military and aircraft centre. In the wetter clay plains and alluvial tracts of the valleys rich pastoral meadows are devoted to dairying. At Aylesbury much milk is condensed and tinned; and Devizes is famous for Wiltshire bacon. The drier clay-lands yield wheat, oats, and barley, and enormous quantities of green vegetables and root crops, which find a ready market in London. In the fine silt of the valleys and on the gravels of the estuarine shores, market gardening and fruit growing are important industries. The fine wheat and pure water of the Chiltern slopes established the straw-plaiting industry at Luton, Dunstable, Hertford, and St. Albans, which now needs imported straw from China, Italy, and Japan; and the paper-making of Watford, Dartford, and Greenhithe depends on their pure water supplies. *Oxford* (57) at the confluence of the Thames and the Cherwell was, at first, merely a safe place in the marshes. It is the most important market and ford town in the clay vale.

Agriculture has endowed its old university, and man has beautified its buildings. *Reading* (92), at the entrance to the Goring Gap, near the confluence of the Kennet and Thames, is an old route centre. Formerly, its staple product was wool from the Chilterns and Downs; now it manufactures biscuits, beer, and agricultural implements. The fertile ground of the river valley enables it also to carry on an extensive business in growing and selling seeds, bulbs, and nursery plants. At the foot of the Marlborough Downs is *Swindon* (55), a creation of the Great Western Railway. Cheapness of the land located its locomotive and carriage works.

London (7,500), " the Imperial Port," the chief city of the world, the world's greatest seaport and financial centre, and the capital of the British Commonwealth, first grew up on a patch of dry ground above the swamps bordering the Thames, at a point where a bridge could be built and near a ford (Westminster), which was the earliest crossing-place of the river. From London the Romans built roads leading in all directions—to Dover, Bath, Lincoln, York, Carlisle, Chester, and Colchester—and afterwards constructed the first London Bridge, at the limit of sea-navigation. The long and broad estuary of the Thames, facing the mouths of the Rhine, the Elbe, and the Scheldt, naturally attracted the early trade passing down those rivers from central and western Europe, and after the discovery of the New World and the sea route to India the city became the half-way house for goods passing between the two hemispheres. Religious persecutions on the Continent resulted in the immigration of Huguenots and Flemings, who helped to make London a great manufacturing centre and the commercial mart of the world. All roads lead to London, and thus practically all the great railway lines have their termini there, and aeroplane routes end. The exceptionally high tides not only compelled the provision of docks from Poplar to Tilbury, but propel the numerous units of the barge fleet, which carry the cargoes up the river, for London is a barge port. London's manufactures are varied, and owe their development to the easy assembling of raw materials and the distributing of the finished products, the great local market, and the excellent human factors. The factories and workshops tend to group themselves together in particular districts, so that in some respects London is a mass of small industrial towns. There are several Londons. In the east are the docks, the banks, the insurance firms, the Exchange, and the markets, grouped round the City of London in the narrow sense. Parliament houses, Government offices, law courts, and ecclesiastical headquarters are grouped round the old city of Westminster in the west. The poorest quarters are the lower areas near the river; the middle-class live mainly in the suburbs; while the wealthy and professional elements live either in the west or outside London. The Port of London includes the whole of the Thames estuary to the Nore. Its quays and warehouses have a total length of nearly 50 miles, and it receives about one-third of the total imports of Britain, and sends out about a quarter of the exports. Convenience of situation has given London a great entrepôt trade, but only by human ingenuity are some of its disadvantages overcome. The centre of the port is practically closed to the intrusion of railways, and motor-lorries carry much of the traffic between the docks and the great goods-yards of the trunk railways. Shipbuilding struggles under the difficulties of crowded waterways, dear labour, and high rates; and outports such as Southampton, Harwich, Queenborough, Newhaven, Folkestone, and Dover are necessary to cope with London's trade. London's position in south-east England, at no great distance from the Continent, and as the key to routes, makes its approaches of great military and naval importance. Chatham, Sheerness, Shoeburyness, Dover, and Portsmouth protect the capital from attacks from east and south. The water supply for London's great population is obtained from the Upper Lea (New River), from the Thames near Windsor, and from deep artesian wells sunk through the chalk to the gault clay. Unlike many great British towns London, as "the gathering place of souls," has world-wide interests, and is cosmopolitan in its outlook. Railway lines radiate from London like the spokes of a wheel, and all are faced with chalk and sometimes limestone barriers. Fortunately, the construction of tunnels is often obviated by the use of wind-gaps and water-gaps in the hills. Near London, there are tunnels where it is cheaper to tunnel the surface than to make the cutting, or where a piece of hilly country is bordered by low-lying land. The Great Eastern (L. & N.E.R.) Railway to Cambridge uses the Lea valley and the Audley End gap; the Great Northern (L. & N.E.R.)

follows roughly the Great North Road, and crosses the chalk by the Stevenage gap; the Midland (L.M. & S.R.) Railway pursues the line of Watling Street, and crosses the chalk by the Luton gap; the London and North-Western (L.M. & S.R.) Railway passes up the Gade valley, and through the Berkhampsted gap; the Metropolitan and Great Central (L. & N.E.R.) Railway uses the valley of the Misbourne and the Wendover gap; while the joint line of the Great Central Railway and the Great Western Railway follows the river Wye through the High Wycombe gap. The Dorking and Basingstoke gaps are used by the Southern Railway. From Paddington the Great Western main-line runs along the low, flat land of the lower Thames valley, and passes royal Windsor. At Reading the line divides, one route proceeding along the Kennet valley viâ Newbury either to Devizes, Bath, and Bristol, or to Taunton and south-western England; the other viâ the Goring gap, either to Oxford, Banbury, Leamington, and Birmingham, or viâ Swindon to Bristol and the direct route north of Bristol to Fishguard through the Severn tunnel.

The Weald. Long ago a great sheet of chalk, several hundreds of feet thick, stretched from Salisbury Plain across the Straits of Dover into France. Earth movements threw it into great up-and-down folds, of which the present Weald between the North and South Downs was the arch of an anticline or upfold, and the great dips of the strata below the Channel to the south and the London basin to the north were complementary synclines or downfolds. From the crest of the long dome, some 3,000 or 4,000 ft. above sea-level, streams flowed north to the Thames valley and south to the Channel, cutting into the chalk and wearing back their sources. At the same time the arch of chalk was gradually weathered down, until the chalk was worn away and the next layer exposed only to be worn away in its turn. The wearing-down process went on until a great horseshoe-shaped hollow was carved out, exposing the edges of a number of different strata—clays and sandstones. Twenty miles southwards from London the steep escarpment of the North Downs faces a clay plain of the Weald. Farther south, the land again rises at the outcrop of a sandy ridge—the Ragstone Range—which attains a height of 965 ft. in Leith Hill. South of this lies a bed of Wealden clay, forming a level plain which rises in the north of Sussex to form the sandstone ridge of the Forest Range. Farther south again, the steep scarp of the South Downs stands above another clay plain. Almost every Wealden river has a pronounced elbow-like bend in it. When the ancient chalk dome was weathered down and valley troughs developed north and south of the sandstone Forest Ridges, a new drainage system was established, running southwards or eastwards along the valley troughs. The old rivers, flowing to the Thames or the English Channel, gradually cut back until they tapped parts of the new drainage systems and diverted them to themselves, thus producing the elbow-bends. Through the gaps cut by the Wealden rivers in the chalk ridges the main-lines of transport pass.

The chief industries of the Wealden lands are agriculture and stock-raising. On the slopes of the Downs enormous numbers of sheep find excellent pasture. Where clayey and sandy beds alternate, or the strata is of a mixed nature, or sand washed from the hills lightens the clays, agriculture predominates. Owing to the growth of London and the need for a greater food supply, market gardens and dairy farms have become important. Fresh methods of forced cultivation have been introduced, and many tons of early peas and potatoes, green vegetables, and tomatoes are grown for the London market. Large crops of wheat, roots, fruit, and hops are produced; Kent, in particular, has so much land given up to orchards and hop-fields, that it is known as "the Garden of England." Its cherries, hops, strawberries, apples, plums, pears, and currants are well known even beyond London. Before the Industrial Revolution the Weald was the chief seat of the English iron industry. Iron ore from the sandstones was smelted by means of the charcoal from the forests which once covered the whole area. Remnants only of the forests now remain, and the iron industry has gravitated to the coalfields. Building-stone from the hard green-sand, chert for road-making, fuller's earth (Nutfield) for removing grease from wool, chalk, sand, clay, and gypsum, are the chief minerals of the Weald. Coal is mined at great depths in the near hinterland of Dover, but the yield is small, although it is certain that large quantities are present.

On the dry chalk downs villages are few, but at the foot of the escarpment some of the water that has sunk down into the chalk, flows out in springs, and it is along this line of springs that most of the oldest villages are found. Other villages with similar advantages stand where the sandstone rests upon clay. The inland market towns are either in, or close to, a wind or water gap in the chalk hills. In the North Downs are Guildford (Wey), Dorking (Mole), Redhill (wind), Rochester and Maidstone (Medway), and Canterbury and Ashford (Stour) ; in the South Downs are Winchester (Itchen), Chichester (wind), Arundel (Arun), Brighton (wind), and Lewes (Ouse). As an invading army marching on London from the south had to pass through some of these gaps, the towns either are, or were formerly, fortified. The coast of Kent and the Wealden portion of Sussex has undergone great changes. The Isle of Thanet, bordered by chalk cliffs, was once separated from the mainland by a navigable channel, now silted up by material deposited by the Stour. It contains the bracing seaside resorts of Margate, Ramsgate, and Broadstairs. Much higher chalk cliffs occur at Dover and Beachy Head. *Dover* (40) stands where a valley breaks the continuity of the chalk cliffs, and at the nearest point to the continent of Europe (Calais is 21 miles away). It is an old Cinque port, a modern packet station and naval base. Its commercial harbour is 75 acres in area, its new national harbour over 600 acres. The Roman fortress and landing-place of Rutupiae (Richborough) stands now 2 miles inland. During the War it was used as a great military transport depôt, and was the English terminus of the train-ferry service with Calais. The mediaeval port of Sandwich has been silted up, and the mouth of the Stour has been diverted several miles to the north by the formation of a shingle bank. Some miles off the sand-dune coast south of Sandwich lie the dangerous shallows of the Goodwin Sands. The deeper water between them and the shore, known as the Downs, gives shelter to shipping from easterly and north-easterly gales. Dungeness, a natural " groyne " of shingle ridges, is due to the deposition of material resulting from the checking of the force of the western tidal current, when it meets the current from the east. The Rother has silted up the old Roman Portus Limanus (modern Lympne), and created the low ground of Romney Marsh, noted for sheep and cattle rearing. Of the Cinque ports—Hastings, Romney, Hythe, Dover, and Sandwich, with the subsidiary ports of Rye, Winchelsea, and Deal—only Dover by artificial aid has retained its original importance, the remainder declining owing to the increase in the draught of ships, and the silting up of the harbours. Other ferry-routes besides Dover-Calais, are: Queenborough-Flushing, Dover-Ostend, Folkestone-Boulogne, and Newhaven-Dieppe. Along the coast are numerous watering-places favoured by Londoners. Among them are Herne Bay, Eastbourne, Folkestone, Hastings, St. Leonards, Bognor, and *Brighton* (142), often called "London-by-the-Sea." Other towns of interest are Dartford and Sittingbourne with paper mills; Maidstone, noted for its beer and vinegar; Canterbury, an ecclesiastical and military centre; and Tunbridge Wells, an inland health resort.

Communications. The main-lines of communication run either east and west, following the direction of the escarpments; or north and south, utilizing the gaps. Thus, the South-Eastern (S.R.) Railway from Reading to Dover enters the Weald by the Wey gap at Guildford, traverses the plain at the foot of the chalk escarpment as far as Reigate, and then follows the Wealden clay to its destination. The London, Brighton and South Coast portion of the Southern Railway serves Surrey and Sussex. From Hastings to Portsmouth it runs from east to west, at first along the clay vale, but after Brighton, along the gentle dip-slope of the chalk. The London and South-Western route utilizes the gaps at Guildford and Petersfield, and the Brighton line the Dorking gap, the Merstham tunnel, the wind-gap near Redhill, and the wind-gap behind Brighton. It reaches Newhaven by the Ouse gap. The South-Eastern lines to Hastings and Folkestone pass through the Ragstone Ridge by a tunnel under Sevenoaks. They branch at Tonbridge, the Hastings line going through Tunbridge Wells, and the Folkestone line following the clay vale of Kent.

The Hampshire Basin, the Isle of Wight, and the Channel Islands. THE HAMPSHIRE BASIN, a shallow downfold of the chalk between the Hampshire Downs, Dorset Downs, and South Downs, has deposits of sand, gravel, clay, and freshwater limestone. There is no boulder clay, as the region is outside the glaciated part of Britain. The Isle of Wight, separated by subsidence and sea erosion from the mainland, is part of the basin. Spithead and the Solent, now deep channels valuable as roadsteads, were formerly the valley of the great main east-flowing river into which the present streams drained.

The flooding of this old valley also created Southampton Water (the drained lower valley of the Avon, Test, and Itchen), Portsmouth harbour, and Poole harbour (the wide shallow lower valley of the Stour and Frome). The chalk of the Hampshire Downs dips below the Spithead-Solent roadstead, and reappears uptilted in the Downs of the centre and the south of the Isle of Wight. North of the series of harbours from Portsmouth eastwards stretches the Portsdown chalk ridge, parallel to the South Downs, providing sites for fortresses protecting the naval harbours. The Needles and the so-called Isle of Purbeck (really a peninsula) are parts of the Dorset chalk ridge. At Lulworth, a bottle-necked cove has been formed by the sea breaking through a narrow-belt of hard rock which lies parallel to the sea, and eating the softer rocks behind. West of Purbeck is the Isle of Portland, linked to the mainland by Chesil Bank, " the most extensive and extraordinary accumulation of shingle in the world," built up by the action of the tidal currents. The oölitic limestone, excellent for building purposes and easily shaped by cutting with a saw, is extensively quarried and exported from Swanage and Wareham. Traces of early civilization are found in the burial mounds, camps, and ridgeways of the Downs, and the sparsity of the population in much of the region has enabled the military authorities to use the land for manoeuvres on a large scale, and the surveyors to fix the base-line here on commencing their survey of England. On Salisbury Plain is ancient Stonehenge, and near Avebury is a stone circle, older still.

Like the Weald, the Hampshire basin was formerly densely forested, its trees supporting the old shipbuilding industry of Southampton and Portsmouth. The New Forest, lying west of Southampton water, is a considerable remnant of these ancient forest-lands. It has wide expanses of gently undulating open country covered with gorse and heather, as well as wooded areas, in which are beautiful glades of fine old oak trees and recent plantations of Scots pine. Ponies and pigs are reared in the open tracts. The chalk uplands are in parts covered with wide expanses of short springy turf, over which generations of shepherds have fed their flocks for thousands of years. Dew-ponds and winter-bournes enable the animals to obtain water. In some places the uplands are cultivated, sometimes with disastrous results. Salisbury Plain resembles a low plateau, and in parts presents a very level surface. It has many folds and dry valleys, and much has now been taken as a training-ground for the army. Its villages are mainly in the valleys, where there is better soil and where water can be got from the streams. Here the fields are cultivated, trees flourish, and rich meadows encourage dairying. The clay areas and many sandy districts are rich agricultural and pastoral lands, producing fruit, wheat, barley, root-crops, hops, vegetables, flowers, and dairy produce. The *Isle of Wight,* one of the " Gardens of England," owes its beauty to its coastal " chines " or rifts, the mildness of its climate, the luxuriance of its vegetation, and the productivity of its soils. Its numerous holiday visitors add largely to its wealth. Cowes, on the Solent, is a centre for yacht racing and yacht building. Ryde, Sandown, Shanklin, and Ventnor are popular holiday resorts. *Newport* (11), its chief town and railway centre, stands at the head of the broad estuary of the Medina, which breaks through the central heights.

From the English Channel the natural route into the interior is by way of the Solent or Spithead to Southampton Water. *Southampton* (161), the chief port on the south coast, stands on the piece of land between the mouths of the Test and the Itchen, and thus has a double water-front. The town became important after the Norman Conquest, when Winchester was England's capital. In the Middle Ages it traded with Venice and the Mediterranean, and later with South America and the East Indies. Its shelter and safe anchorage, its double tides giving easy entrance by day or night, its docks on the double front, and excellent railway communications, make it to some extent the outport of London, and give it exceptional advantages on the great routes to the New World and the East. Nearness to Aldershot, Salisbury Plain, and Havre causes it to be a military and ferry port. *Portsmouth* (247), the chief British naval dockyard, stands on Spithead, at the entrance to an almost landlocked harbour, elaborately protected by forts. Its Royal dockyard dates from Tudor times, and still maintains its importance in spite of the fact that it is far from the coal and iron fields, and that the south coast is not now the one most liable to be attacked. *Bournemouth* (92) is a pine-clad modern pleasure resort, excellently served by railways. *Winchester* (24), where the valley of the

Itchen narrows, was a British settlement, a Roman camp, the centre of Wessex, and for a time the capital of England. To-day, it is a market town with ancient fortifications and a cathedral speaking of its past glory. *Weymouth* (25), provided with a splendid naval harbour sheltered by artificial breakwaters and Chesil Bank, is a seaside resort, fishing centre, and ferry-port for the Channel Islands and St. Malo. Salisbury, Basingstoke, Alton, Romsey, Petersfield, and Dorchester are market towns.

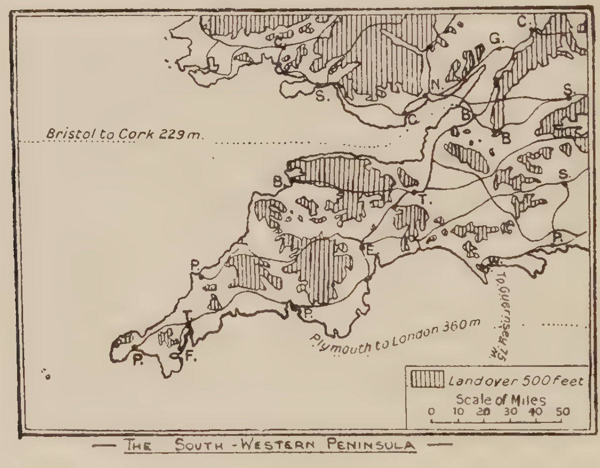
The district is well supplied with railways. The London and South-Western (S.R.) main-line from Waterloo passes through Woking to Basingstoke, where the line forks, one branch proceeding to Winchester, Southampton, and Bournemouth, the other to Andover, Salisbury, and the west. Another route of the South-Western proceeds viâ Guildford to Portsmouth, and thence by ferry to the Isle of Wight. The London, Brighton and South Coast (S.R.) Railway runs along the coast from Brighton to Portsmouth, while the Great Western enters both from Newbury and Reading, and the Midland (L.M. & S.R.) reaches Bournemouth from the north-west.

THE CHANNEL ISLANDS. Jersey, Guernsey, Alderney, Sark, and some smaller islands—which are all that remain of England's once great continental possessions—are, structurally, part of France. They are the remains of the old kingdom of Neustria and the dukedom of Normandy. To-day, they enjoy a large measure of autonomy, and have their own laws and customs. Resemblance to England's south-western peninsula is seen in their wave-beaten, rugged, cliff-edged coasts ; the beautiful colours of the landscape ; their attraction of summer visitors ; their equable climate and growth of early vegetables and flowers ; and their rich grazing lands on which the valuable Jersey, Guernsey, and Alderney cattle are fed. Granite is quarried, and fishing is naturally an important occupation. Surplus fish and seaweed (vraic) are used as manure. St. Helier in Jersey, and St. Peter's Port in Guernsey, are the chief towns. The inhabitants, who number nearly 100,000, speak a French " patois."

(*f*) SOUTH-WESTERN ENGLAND.

South-western England is a peninsula extending further south than any other part of the British Isles, and embraces the greater part of Somerset, western Dorset, and the whole of Devon and Cornwall. The Mendip Hills of north Somerset form a complete upfold of mountain limestone separating the Plain of Somerset from the basin of the Bristol Avon. Magnificent crags, steep cliffs, and deep gorges have resulted from the weathering of the limestone, and underground streams and caverns are characteristic of the region. The noted Cheddar Gorge is probably the weathered-out channel of an ancient stream, which flowed through prehistoric caverns whose roofs collapsed, and thus formed the gorge. East of the Mendips the oölitic limestone of the Cotswolds continues through western Dorset to the coast, where it forms Portland Isle. Between the limestone of the Mendips and the sandstone of the Quantocks lies the low, flat plain of Somerset, across which the Parret and other rivers flow sluggishly to the Bristol Channel. Like the Fens, it is largely composed of alluvium, but unlike them it has a greater proportion of peat, and its " islands " are not low and clayey, but often fairly high steep-sided hills. Legend says that it was to Glastonbury Tor, on the Isle of Avalon, that King Arthur went to die, and that it was in the Isle of Athelney that Alfred took refuge from the Danes. To-day, the once almost impassable swamp is drained by a network of canals, and is a prosperous pastoral and agricultural region.

Devonshire. South of the Bristol Channel, Exmoor rises steeply from the sea to well over 1,000 ft. It is formed of slate, hard sandstone, and limestone. Inland, the uplands form a high plateau with swelling hills, and deep valleys (" Combes ") cut out by the southward flowing streams which join the Exe. The " Combes " are noisy with flashing streams and crowded with trees ; elsewhere the wild, open moorland is a land of bracken, heather, and grass, fit home for the red deer, hardy ponies, and sheep. South of Exmoor is the broad plain of Devon through which run the Taw and the Torridge to Barnstaple Bay on the north, and the Exe to the greater bay on the south coast. In the north-west of the plain the ground is formed of sandstones and shales which weather into poor soils ; in the eastern portion there are " New Red " sands and clays, which form the " good red earth." South-west of the Plain of Devon rises the upland of Dartmoor, a highland of granite rising out of a sea of slate. Great Links Tor, its highest point, attains 2,039 ft. The top of the upland consists of high rocky ground with huge blocks of weather-worn granite, called tors. Below this come great sweeps of heather and furze-clad downs, and here and there peat bogs, which are the sources of most of the Devon rivers. Into its heart creep some of the lovely valleys of south Devon. The weathering and decomposition of the granite, continued through long ages, has produced the fine white clay, kaolin, which is shipped from Fowey and Teignmouth to the Potteries and the cotton mills of Lancashire. Across the Exe from Dartmoor are the green-sand Blackdown Hills which are separated from Exmoor by the Vale of Taunton, in which lies the Great Western Canal linking Taunton and Tiverton. West of Dartmoor lies the deep cleft of the Tamar valley, noted for its great fertility. Its drained lower portion forms Plymouth Sound. Beyond rise the granite Bodmin Moors, with other granite masses farther west at St. Austell, Redruth, and Land's End. About 25 miles south-west of Land's End lie the Scilly Isles, the remnants of an old land area. They form a group of some 150 granite islands and rocks, of which only five are inhabited.



— THE SOUTH-WESTERN PENINSULA —

The coasts of the south-west are generally high and rocky, except where the flat plain of Sedgemoor comes down to the sea. The whole district is much exposed to the violence of the Atlantic breakers, consequently the coastal sills are few and narrow. Subsidence has caused the drowning of the lower valleys of most of the rivers, thus producing such magnificent rias as those of Falmouth and Plymouth Sounds. The gabbro and serpentine of the Lizard, the granite of Land's End, and the cliffs of contorted rocks at Bude, are all worn into fantastic shapes. Lundy Island, off Barnstaple Bay, is a volcanic mass, outlying from Exmoor.

Industries. Fishing, the oldest industry, is a natural occupation of this region. Its many coves and harbours along the indented coastline shelter little fishing fleets; and its sailors, since Elizabethan days, have been renowned for their love of adventure, fortitude, and colonizing powers. St. Ives, Newlyn, and Penzance are centres for the mackerel (March-June) and pilchard (July-December) fisheries; and St. Ives is the chief centre of the herring (January-March) fishery. Plymouth, Brixham, and Falmouth are famous trawling centres. On the granite moors and on Exmoor there is much waste land, and generally the occupations of the highlands are mining, quarrying, the exporting of kaolin, and the rearing of animals. Tin, lead, zinc, copper, arsenic, bismuth, chromium, and tungsten are found in veins among the slaty rocks in the margins of the granites. Mining for tin and copper has been carried on from time immemoral, and the output, especially of copper, is now small. At Truro, St. Just, and Bodmin, these ores are still mined and sent to South Wales to be smelted, though a small amount is smelted at Redruth, Truro, and Camborne by means of imported coal. Tungsten, formerly a waste product of the tin-mining, is now valuable for hardening steel. Lead was once mined in the Mendips, and in the basins of the Teign and the Tamar. Pitchblende, from which radium is extracted, is obtained at the Trenwith mine near St. Ives. Granite is quarried for building purposes, and slate for roofing. Kaolin is most abundant around St. Austell (the Hensbarrow district) and Bodmin, and on Dartmoor. Hardy ponies run wild on Dartmoor and Exmoor, and sheep graze over the slopes of the Mendips and the limestone heights in the east.

The lowlands are essentially agricultural, particularly the plains of Somerset and Devon and the Vale of Taunton, which produce fruits and cereals, and have many dairy farms. Red cattle, red cider, Cheddar cheese, and Devonshire cream are all famed. The mildness of the climate permits sub-tropical plants to flourish, and the early warmth of spring enables the growers of vegetables (broccoli, asparagus, and potatoes), flowers (wallflowers, daffodils, narcissi, and lilies), and fruit (apples and pears, stone- and berry-fruits) to secure good prices for their early products, in spite of costly transit to the industrial centres. Holiday-makers, invalids, and artists are attracted by the magnificent coast and inland scenery, and the mild winters. Among the chief resorts are Ilfracombe, Torquay, Lynton, Weston-super-Mare, and Clevedon. Home industries in lace still survive at Honiton and Tiverton.

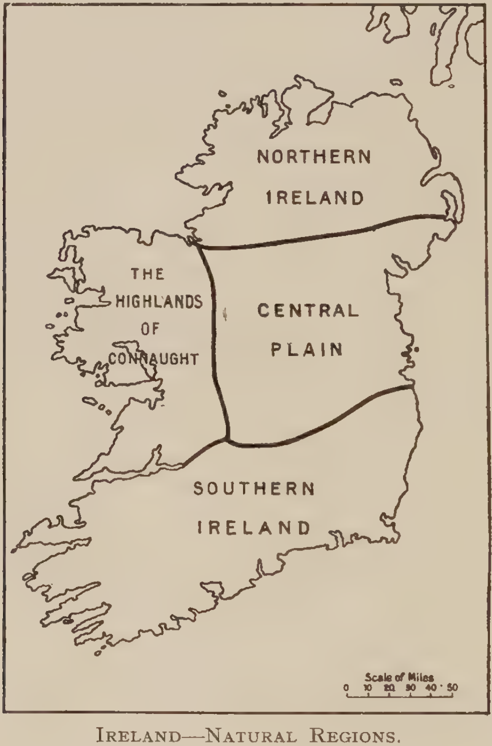
Communications. Before the drainage of Sedgemoor, south-western England was almost isolated from the rest of England, and its people still stand somewhat apart. Old ways and speech still persist; and sternness and hardness of character, noticeable in miner, fisherman, and farmer, are born of the environment. The chief railways serving the peninsula are the Great Western and the London and South-Western (S.R.). The Great Western main route from London meets at Taunton another line from Bristol which rounds the western margin of the Mendips. From Taunton the main-line proceeds to Exeter along the plains between Exmoor and the Blackdown Hills, and then through Plymouth, St. Austell, and Truro to Penzance. An important branch-line runs from Taunton to Barnstaple, Bideford, and Ilfracombe. The barrier of Dartmoor compels the London and South-Western Railway after leaving Exeter to follow its northern margins, viâ Crediton and Okehampton, to Plymouth, and the Great Western Railway its southern margins. *Plymouth*, with Devonport (naval station) and Stonehouse, the "Three Towns" (210), is the largest and one of the finest cities of the south-west. It is a great mail and passenger port, and a port of call for South African and Eastern boats. Plymouth Sound, sheltered by its famous breakwater, is a fine harbour upon which converges the traffic from a number of inland routes. Far out beyond the harbour stands the Eddystone Lighthouse, the safeguard for ships steaming up-channel between the Lizard and Start Point. *Exeter* (60), the bridge port of the Exe, old Roman town and cathedral city, is at the convergence of valley routes. The architecture of its old buildings earns for it the name of the "Queen of the West." It is now a market town, with small industrial enterprises such as paper-mills, tanneries, and the making of agricultural implements. Smaller towns are: Taunton (market town), Bridgwater and Falmouth (ports), Wells (cathedral city), and Honiton (lace and Axminster carpets).

IRELAND.

> "In her sun, in her soil, in her station thrice blest,
> With her back towards Britain, her face to the west,
> Eire stands proudly insular, on her steep shore,
> And strikes her high harp 'mid ocean's deep roar."
> —*William Drennan.*

Ireland, the land of crag and glen, of lake and plain, is an outlier of Great Britain, an island standing near the edge of the continental shelf, inviting attack. Rather larger than Scotland, its population is less (4,500,000), and more evenly distributed. Its flora and fauna contain fewer varieties than the larger sister island; and its physical build is peculiar to itself, though there is no physical division of Ireland which has not its counterpart in Great Britain; and every Irish region is a continuation of a similar one across the narrow seas. The mountains of Donegal, Mayo, and Connemara continue the Scottish Highlands; the volcanic plateau of Antrim is part of the same area as the volcanic islands of the Inner Hebrides; the Mourne Mountains prolong the southern Uplands of Scotland; the Wicklow mountains resemble those of Wales; the south-western mountains find their counterpart in southern Wales and south-western England; and the low-lying Central Plain, like the English Midland Plain, is a continuation of the Great European Plain. The true Irish people of the south, south-west and west feel themselves to be a distinct nation. They have kept their own language; feel the fascination of the land; and in spite of British laws impeding their agriculture and commerce in the past, many have remained rooted to this once distressful country, though emigration has been great. In character they are courteous, quick in perception, humorous and apt of expression, conservative in method, with a deep sense of the supernatural in ordinary life. Parts of the east and most of the north are more akin in race, work, and outlook to the sister island.

(*a*) **THE CENTRAL PLAIN.**—The Central Plain of Ireland, covering about one-third of the total surface, stretches roughly between Drogheda and Dublin on the east, and between Donegal Bay and Galway Bay on the west. It is composed of carboniferous limestone, floored in many parts with boulder clay, which originated in the time of the Great Ice Age, when probably the coal measures



Ireland—Natural Regions.

—except the small fields in Kilkenny, Cork, and Limerick—were worn away, to the detriment of Irish industry. The surface is gently undulating, the lowest land being in the river valleys ; and, although the water-partings exceed 250 ft., few heights attain 500 ft. Cole describes the landscape as " soft and pleasing, tender in its tints of green and brown." Here and there the plain is dotted by small moraine-dammed lakes, but most of the large lakes are in hollows produced by the solvent power of acid waters on the underlying limestone. One-eighth of Ireland is covered with bogs, of which the largest is the Bog of Allen (nearly 400 square miles), extending from about 20 miles west of Dublin across the lowland almost as far as the Shannon. Bogs are black, spongy, shaky, water-swollen cakes of sodden plant-remains—sphagnum, mosses, cotton grass, and heather. They form in shallow, stagnant lakes, or on cold, wet, mountain slopes. Peat, the chief fuel in Ireland, is dug from the bogs by a special spade in lumps a little larger than a brick, and then stacked until dry enough to be used as fuel. It is also used as litter in cattle sheds, and for various industrial purposes. Main roads and railways either avoid the bogs, or cross them on causeways resting on the solid rock below the surface of the bogs. Upland bogs sometimes overflow and slow avalanches of mud descend into the valleys, burying farms and villages.

The western portion of the Central Plain is practically the basin of the Shannon, the longest river in the British Isles. This river rises in the sandstone scarp of Cuilcagh, and flows sluggishly over the plain. It continually expands into solution lakes, the most notable of which are Loughs Allen, Ree, and Derg. Between Lough Derg and Limerick the river cuts through the obstruction of the Slieve Bernagh-Arra mass, forming the beautiful gorge of Killaloe, and falling 100 ft. in less than 20 miles. The series of rapids formed impede navigation, but a canal built round the rapids surmounts the impediment, and renders the Shannon navigable for river boats for about 200 miles. Beyond the gorge the river passes to Limerick, with the Golden Vale on the left, and, later, opens out into its wide and long estuary, the inner part of which is probably a solution lake, and the outer part a ria. The Shannon is of little importance, for it flows through a region only sparsely populated, and its estuary opens away from the markets of Britain. Loughs Conn, Mask, and Corrib, the two last-named being joined by an underground channel, mark the western boundary of the plain, and here boulder clay is sparse. Eastwards the plain slopes to the Irish Sea, and is largely drained by the Boyne and the Liffey. On both east and west the plain reaches the sea.

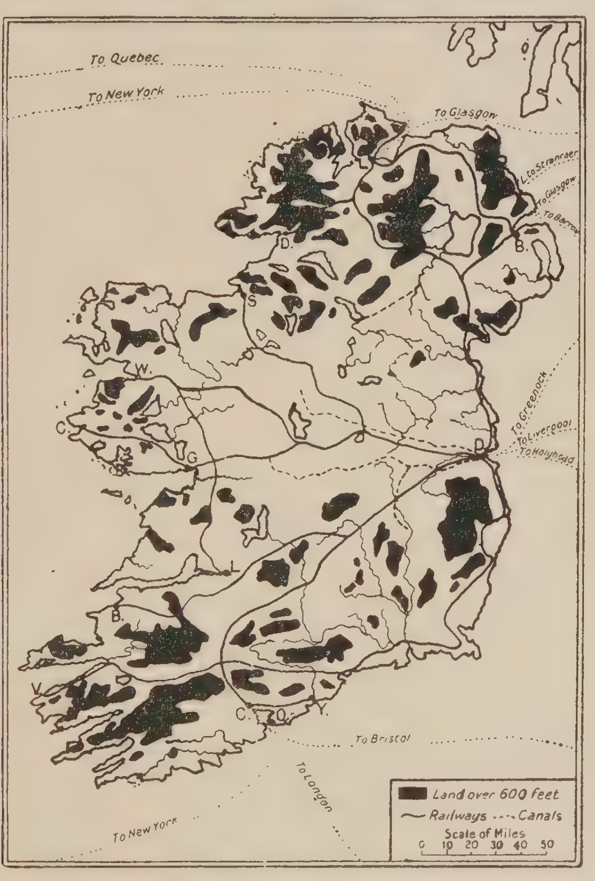
Owing to the mild, wet climate, the absence of coal, and the suitability of the soil for pasture purposes, the main occupations are connected with dairy produce and the rearing of live-stock.

Less than one-tenth of the area is under crops, the drier east having the greater amount of cultivated land. Oats and barley are the chief cereals, while potatoes, the staple food, are widely grown, but more especially in the west. Potatoes and buttermilk are often employed in fattening cattle and pigs, and much of this fat stock is sent through Dublin to British markets.

Communications. The most important routes are those which reach the east coast, where the plain stretches widely between the Wicklow and Mourne Mountains, and opens towards the English plain. Railways and canals radiate easily from Dublin across the plain and along the east coast. The Grand Canal from the south side of Dublin, and the little-used Royal Canal from the north, connect it with the Shannon, the Royal at a point above Lough Ree, the Grand between Lough Ree and Lough Derg, whence it continues to Ballinasloe. Like English canals they have partly decayed. Railways meet the obstacles of rivers and bogs, and suffer from inefficient working. The Great Southern and Western portion of the Great Southern Railway of Ireland connects Dublin with Cork, Waterford, Limerick, and Sligo ; and the Midland Great Western portion of the same railway links Dublin with Athlone, Galway, and Clifden. The Great Northern runs through Drogheda and Dundalk to Belfast and Londonderry ; while the Dublin and South-Eastern passes through Bray and Wicklow to Wexford and Rosslare.

Towns. *Dublin* (402), the capital of the Irish Free State, stands at the mouth of the Liffey, where the river enters a sheltered bay near the Head of Howth. Its site, easy of defence, and very favourable for trade—it faces the Cheshire Gap, and all Irish mainland routes converge on it—caused it to become the chief collector and distributor of Irish produce, and the seat of government. Its most important industries are the making of poplin, dyeing, the brewing of beer, and the distilling of whisky. It is a city of spacious buildings, wide streets, and great views. Kingstown (old Dunleary) is an outport of Dublin, and is the port for the mail steamers to Holyhead. Drogheda on the Boyne, and Dundalk on Dundalk Bay, export the produce of the plain, and have linen industries. Greenore, at the mouth of Carlingford Lough, is a ferry town for Holyhead, and the natural port of the small local linen industries and the rich agricultural lands behind it. Athlone, Mullingar, and

Ballinasloe are market centres at points where road, river, rail, and canal routes meet. Galway and Sligo, with splendid situations but poor hinterlands, are small ports exporting cattle and dairy produce.



IRELAND.

They were important, especially the former, in the days when they were the half-way houses for the commerce between Scandinavia and the Mediterranean lands. *Limerick* (38), the largest city of the west, has a large coasting and river trade. It is a bridge port at the head of the Shannon estuary, and taps the trade of the fertile " Golden Vale," which runs south of Limerick and as far as

Tipperary. The city manufactures leather, lace, tobacco, and agricultural machinery; has bacon-curing establishments; and exports cattle and dairy produce.

(*b*) **THE HIGHLANDS OF WESTERN CONNAUGHT.**—The Western Highlands, the poorest region of Ireland and the freest of foreign elements, are a continuation of the Scottish Highlands, though less extensive, and at a lower elevation. Some parts of the region are really lowlands, and other parts have been drowned by the sea. Deep indentations reach far into the land; stacks and skerries line the shore; and steep, high cliffs of contorted rocks on mainland and islands boldly confront the broad Atlantic. There are three distinct upland masses: the Ox Mountains between Sligo Bay and Killala Bay; the district of north-west Mayo between Killala Bay and Clew Bay; and the Connemara district between Clew Bay and Galway Bay. Connemara is famous for its wild and awe-inspiring scenery, which attracts visitors in increasing numbers each year, thus adding to the meagre wealth of the peasants. Its treeless tops, covered with boulders, is a fitting abode of the rainstorms and fierce westerly gales that blow so often over it. "It is in the evening, especially among the bogs, that this West of Ireland is perhaps most enchanting, when the greens of grass and foliage—always richer than the greens of England—deepen through Prussian blue to indigo, the tawny bog turns to rose-madder and warm sepia, and the grey walls darken to purple." (*G. J. Cole.*) To the peasant the purple hills have an enduring fascination in spite of their wetness and their infertility.

Industries. Nearly all the inhabitants are either poor or on the verge of poverty. The population is scanty, and there is a steady emigration to America. It is a Region of Lasting Difficulty, exporting men. Agriculture and fishing have been assisted by the Congested Districts Board, but are far from thriving. Cattle, horses, and pigs are reared on the lowlands, and some sheep are pastured in the highlands. The women look after the poultry, and do a little knitting and weaving. Quarrying is carried on in the Connemara Mountains, and the famous serpentine marbles (dark green and red) are largely used for purposes of decoration, and also for building. Westport, Killala, and Newport are small fishing ports, which act as gates to the Central Plain. Claremorris is an important railway focus, and Clifden is a great trans-Atlantic wireless station.

(*c*) **SOUTHERN IRELAND.**—A line drawn from Dublin to Limerick cuts off a portion of Ireland, more irregular than the Central Plain, but yet displaying a certain regularity in the arrangements of mountains and plains which suggests some common origin. The mountains of Cork and Kerry, the most continuous in Ireland, consist mainly of parallel ridges of Old Red Sandstone with intervening valleys of shale and limestone, running generally in an east-and-west direction, recalling the mountains of South Wales. At the northern base of the highest ridge, the MacGillycuddy's Reeks, are the lovely Lakes of Killarney, above which rises Carrantual (3,414 ft.), the highest peak in Ireland. The charm of the lakes lies in the blending of mountain and lake, the woodland scenery, and the smother of emerald green on the valley sides. In the far south-west, the valleys of the rivers which once flowed westward have been drowned by the general sinking of the western coast, and thus have originated the rias of Dunmanus Bay, Tralee Bay, Bantry Bay, Dingle Bay, and Kenmare " River," separated by high ridges which form peninsulas ending in bold headlands and detached islands. The rias form magnificent harbours, but are not backed by productive hinterlands, and their main use is for naval purposes, Bere Haven, in Dingle Bay, being an important naval base. South of Dingle Bay is Valentia Island, the starting-point of several Atlantic cables, and the most westerly of British Meteorological stations, announcing first the approach of the Atlantic cyclones. Clear Island has the Fastnet Lighthouse near it, and is a signalling station engaged in reporting the movements of Atlantic vessels. The rivers Bandon, Lee, Blackwater, and lower Suir, have peculiar courses, since they take easterly routes, and afterwards enter the sea at right angles to their original courses. Jukes explains this peculiarity as the result of a consequent drainage to the south before the centre of Ireland was lowered to its present level, and the development of subsequent strike streams along the softer limestone of the downfolds.

The Wicklow Hills in the south-east have the same N.E.-S.W. direction as in the west. They are largely composed of granite, and rise in Lugnaquilla to over 3,000 ft. Their broad, rounded summits form high heather-clad moorlands with many bogs, and their valley forests please the eye of poet and artist, especially in the Vale of Avoca. The Liffey flows westward from the Wicklows, and then curves eastward round the northern base to Dublin Bay; while the Slaney runs southward to Wexford Harbour. The Nore from the Slieve Bloom uplands, the Barrow from the peaty moors in the neighbourhood of the Bog of Allen, and the Suir from the east of the Silvermine Mountains, flow into Waterford Harbour.

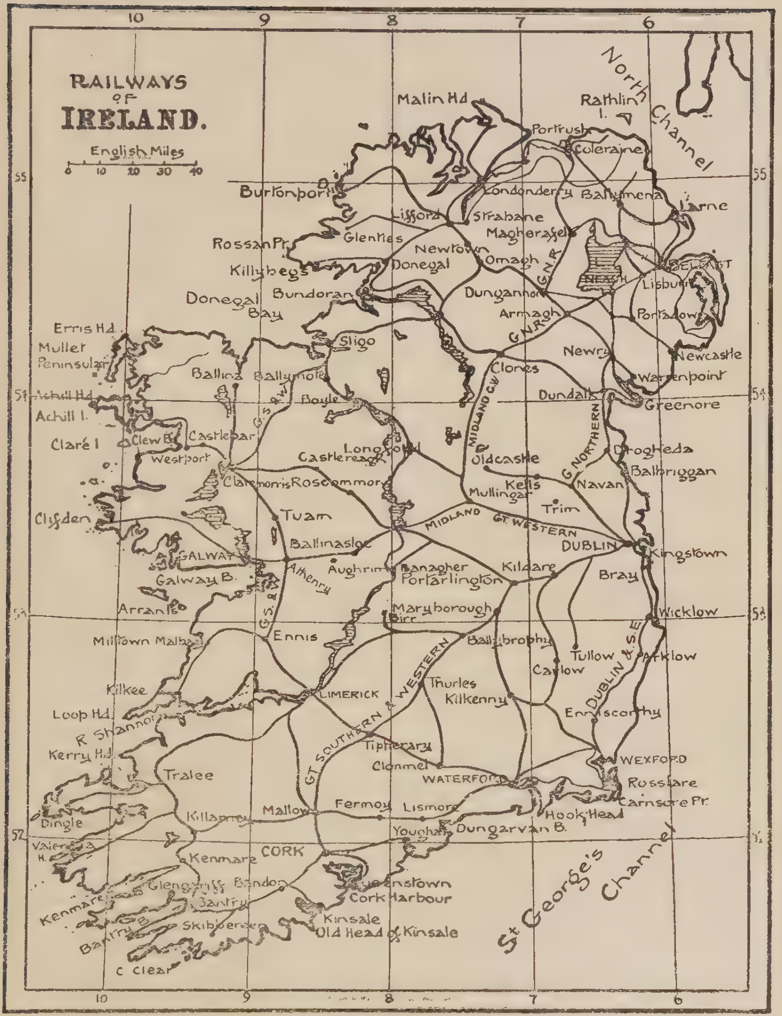
Industries. In the south-west the mild winters, small range of temperature, and the abundant rainfall, favour pastoral pursuits rather than the cultivation of fruit or wheat. Wheat grows well only in the sheltered Golden Vale, south-west of Limerick. Over the rest of the district barley is the chief cereal. The main wealth is derived from the rearing of cattle and pigs. In the highlands the harsh climatic and soil conditions make the population very scanty. Fishing, especially for mackerel, is pursued from fishing villages by the sheltered inlets. In the south-east the drier climate and the greater extent of lowland have encouraged agriculture more than in the south-west, though dairying is still the most important occupation. Barley is extensively grown, and has given rise to whisky distilleries at Kilkenny and Waterford. Near Carlow is the largest coal-field in Ireland, but the quantity mined is very small, and no manufactures, based on the coal, have grown up in the neighbourhood. Copper and lead are mined in the Wicklows, and small quantities of gold are sometimes found in the river beds. Granite, limestone, and red sandstone are obtained from the mountains, and slate is quarried in Wicklow and in Tipperary. The great co-operative movement of recent years has done much to ensure prosperity to the dairy industry.

Communications. Roads and railways are closely controlled by the relief, and generally follow the river valleys. *Cork* (77), at the head of the Lee estuary, the largest and most important town in southern Ireland, centres the commerce and most of the industries of the south-west. Its great harbour, with 4 miles of quays and protected by a narrow entrance, caused its growth as a port. It has bacon-curing, distilling, tanning, and condensed-milk industries, and exports great quantities of cattle, bacon, ham, cheese, poultry, butter, and eggs to Britain, chiefly through Bristol. Queenstown, on wooded Great Island, is its outport, and port of call for many of the American mail and passenger steamers. The mail route to Dublin and Kingstown passes through Mallow in the Blackwater Gap, sweeps round the northern margins of the Galtee Mountains, and then crosses the Central Plain to Dublin. In the neighbourhood of Cork the making of lace and woollen goods still survives as a cottage industry. Waterford and Wexford export the produce of the rich vales of the Suir, Barrow, and Slaney; but Rosslare, furnished with a new deep harbour, is the chief ferry port, with fast steamship connections with Fishguard. Kinsale, Youghal, and Dungannon are smaller ports, exporting the dairy produce of the southern valleys. The chief inland agricultural centres are: Tipperary, Cashel, and Clonmel in the Golden Vale; Kilkenny on the Nore; and Carlow on the Barrow. From the earliest times the agriculture of the south-east was important, a fact attested by the many ruined castles, abbeys, and monasteries of the region. Bagenalstown, on the Barrow, is a railway centre with trade in granite, slate, and sandstone from the Leinster ranges and the Wicklow Hills. Cashel is interesting as the capital of the old kings of Munster, and for its typical Irish round tower.

(*d*) **NORTHERN IRELAND.**—The north of Ireland is a region of highland masses, separated by belts of lowland drained by rivers. Structurally it forms two divisions. West of the broad lowlands of the Bann, the N.E.-S.W. direction of the granitic and crystalline mountains, and the fiord type of coast, show them to be outliers of the Caledonian Highlands; eastwards, the lava-capped basalt plateau of Antrim is a continuation of the lava flows of the Inner Hebrides; and the much-dissected granitic and volcanic Mourne Mountains repeat the Southern Uplands. Between the Donegal and Sperrin masses in the west lies the valley of the Foyle, terminating in a wide, almost land-locked estuary. Lough Neagh, drained by the Bann, differs greatly from the other lakes of Ireland. It is a depression lake formed in the Rift Valley extension of the Scottish Midlands. The Lagan basin, with the drowned estuary of Belfast Lough, separates the Antrim plateau from the Mourne Mountains.

Industries. In racial traits, in religion, in industrial ability, and in agricultural methods, much of Northern Ireland is unlike the other regions. Its north-eastern portion is the richest and the most densely populated region of Ireland, the home of the greatest Irish manufacturing industry, and of intensive Irish agriculture. Ulster raises nearly all the flax, and about half the oats grown in the island. Agriculture is naturally more important in the east than in the west, for it has richer lowlands and a drier climate. Dairy-farming and pig-keeping are carried on in all the valleys and plains, and sheep are reared on the hill pastures, especially in Donegal. The chief industrial region lies east of a line joining Londonderry with Newry. Linen-making is the main industry. The home-grown flax, supplemented by supplies from Belgium and the Baltic countries, Scottish coal and machinery, Scottish skill and organizing ability, the pure water for washing and bleaching, the moist climate, and the cheap labour, are the factors which make it prosperous. Belfast is the chief centre, but many other towns are engaged in it. Such are Londonderry (shirts), Lisburn (damasks), Portadown and Lurgan (cambrics and lawns), Monaghan and Armagh (brown holland), Lurgan and Enniskillen (bleaching), Larne (handkerchiefs), Newry (flax-spinning), and Coleraine (shirts). Another important industry is shipbuilding carried on at Belfast and, to a less extent, at Londonderry. Natural advantages are few ; but the efficiency of the workmen, the exceptional ability of the founders of the industry, the ease of obtaining coal and steel from south-western Scotland and north-western England, the good accommodation for the building and launching of ships, especially at Belfast, and the fact that the women work in the linen factories and the men in the shipyards thus securing cheap labour, have been, and are, the main factors in the great success of the Ulster shipyards. The output of coal from the Ballycastle and Dungannon collieries is very small. Bauxite and iron ore, found in the basalts of Antrim, are mined at Ballymena and Glenarm. The aluminium ore is shipped to Kinlochleven, the iron ore to Ayrshire. Donegal, stony and damp, is very sparsely populated. Its people are poor, and engage in fishing, the rearing of cattle, sheep, and pigs, and the home industry of tweed-making.

Belfast (385), with suburbs (500), the largest city in Ireland, is at the head of Belfast Lough at the mouth of the river Lagan. Besides its enormous linen factories and the famous shipyards of Harland



RAILWAYS OF IRELAND

and Wolff, it has breweries, distilleries, potteries, tobacco factories, rope works, and bacon-curing and flour-milling establishments. Its trade is far greater than that of any other Irish port, for it is the gateway of the most productive part of the country. *Londonderry* (41) is a walled city, on a hill partly surrounded by the Foyle, near its entrance into Lough Foyle. It has large shirt factories, and also tanneries, distilleries, and shipyards. At the entrance to Lough Foyle is Moville, the outport of Derry, and the calling port for Atlantic liners taking the northern route to America. Some of the passenger traffic of Belfast is carried on through Larne, from which mail-steamers ply to Stranraer. Other towns are: Portrush, the tourist centre for the Giant's Causeway ; Armagh, the ecclesiastical capital ; and Rosstrevor and Bangor, watering-places.

Communications. The main roads and railways of Northern Ireland avoid the highlands and follow the river valleys and plains. From Belfast, the Northern Counties of Ireland Railway runs to Larne, and also through Antrim to Coleraine. At Coleraine a branch proceeds to Portrush, while another runs to Londonderry. From Londonderry the County Donegal Railway runs to Strabane, Donegal, and Ballyshannon. The Great Northern of Ireland divides at Scarva Junction ; one line proceeding north by west to Omagh and thence north to Newton Stewart, Strabane, and Londonderry ; the other by way of Armagh to Clones, and thence to Enniskillen, turning north at that point through Bundoran Junction to Omagh, and also west to Bundoran. From Dundalk the Dundalk, Newry and Greenore Railway proceeds through Greenore and Scarva Junction to Lisburn, Belfast, and Antrim. Communication between the industrial centres is aided by the Ulster canals. The Newry Canal connects Carlingford Lough with the river Bann, near Portadown ; the Lagan Navigation links Lough Neagh with the river Lagan near Lisburn ; and the Ulster Canal joins the Lough Erne system with the Blackwater and Lough Neagh, viâ Clones and Monaghan.

CHAPTER XIV

BRITISH COMMERCE

"Trade is the life-blood of the British Empire."—*Rutter.*

THE United Kingdom is the leading commercial country of the World, but her supremacy came late and was hard won. Her position as a focus of trade originated with the conquest of the ocean; her genius for massive production came with the Industrial Revolution; and her shipping grew with the growth of her colonies and the decline of her rivals—France and Holland. Her climate favours human energy; her abundant and easily accessible stores of coal and iron have been a vital factor in her industrial progress; her efficient human labour has revolutionized modern industry; and her comparatively great freedom from irksome trade restrictions and internal and external strife has powerfully aided her trade. The concentration of population in the industrial regions has facilitated the organization of her industry; the abundance of capital—the reward of energy, skill, and thrift—has steadily expanded the growth of her trade; and the nearness of the coast on both sides, the abundance of seaports, and the completeness of the communications both by land and sea, have made easy her access to many markets. She possesses other important advantages in the spread of the English language throughout the globe; the confidence reposed in British fair dealing; the strongly established trading relations; the love of adventure and the sea, characteristic of many of her people; and the British genius for invention.

Against these potent advantages must be placed the disadvantages—mainly minor—of the dearness of land and labour; the high freight rates (rail); the restrictions on labour (Factory Acts and Trade Union Regulations); the irrational spelling; the need of better technical and commercial education; the absence of a decimal system; and the high tariffs of other nations. Strong competitors—the United States, Germany, France, Italy, and Japan—who have gained much from British methods, inventions and capital, are now in the world market, and they have normally increased their trade at a more rapid rate than Britain in recent years, and have not so largely drawn on their natural resources. Such advance is natural, and should not occasion pessimism in Britain. British capital is invested in many lands ; her banking and insurance systems aid the whole world ; her shipping occupies the premier position ; her government is stable and enlightened ; and so long as her people utilize to the fullest extent her unrivalled position for trade, their own excellent organizing, inventive, and initiative powers, and the resources of the Britains overseas, and of their own Motherland, and keep their reputation for quality, Britain should retain her proud position. As British commerce is all sea-borne, the importance of the Navy and the Mercantile Marine cannot be over-estimated. "Formerly our force of shipping contributed greatly to our trade and safety ; now it has become indispensable to our very being." (*Government Report on Shipping Cd.* 9092.)

TABLE I.—TRADE OF THE UNITED KINGDOM.

Total Trade in Millions of Pounds. Average 1911, 1912, 1913.	Percentage of Exports.	Percentage of Imports.	Total Trade in Millions of Pounds. Average 1921, 1922, 1923.	Percentage of Exports.	Percentage of Imports.
£1,327	45%	55%	£1,902	44%	56%

NATIONAL TRADE BALANCE, 1923. (*Board of Trade Journal.*)

	Imports in Millions of £'s.	Exports in Millions of £'s.
Bullion	53	69
Merchandise	1,105	886
Interest on Investments	50 (U.S.A. Debt)	200 (Interest on Foreign Investments)
Shipping Payments	30	140
Commissions	—	30
Balance of Miscellaneous Services	—	10
Available for Investment Abroad	97	—
Total	£1,335	£1,335

THE BALANCE OF TRADE.—The striking fact of the table above is the predominance of merchandise imports over exports ; and, as exports must balance imports in the long run, the factors explaining this apparent anomaly are important. Great Britain, for approximately a century, has been a mature lending country, her trade balance being marked normally by an excess of imports. Her " invisible exports " of services—banking, insurance, shipping, and investments—exceed by many millions her " invisible imports " of services, more than accounting for the whole of the so-called " unfavourable " balance. It was estimated in 1923, that the interest received on British investments in the Empire and foreign countries, after allowing for the £50,000,000 paid annually to the United States for Britain's war debt, amounted to £150,000,000; that the amount received for shipping services, after allowing £30,000,000 for foreign services, was £110,000,000; and that the earnings from banking, insurance, and other services exceeded similar foreign services by £40,000,000. A minor factor in the discrepancy is the fact that imports are valued with the addition of insurance and freight charges, while the exports are estimated on their value as they leave the port, that is, free on board. Britain has a large entrepôt trade—a re-export of colonial and foreign goods —amounting normally to an annual average of over £100,000,000. Her vast shipping, well-organized markets, and favourable location, make her ports, especially London, excellent centres for the distribution of such commodities as cotton, wool, rubber, tin, tobacco, and tea to foreign markets. Though this lucrative trade has declined somewhat, because world-markets are becoming international, British ports compare very favourably with New York, Antwerp, and Hamburg.

TABLE II.—WORLD TRADE AND PERCENTAGE OF WORLD TRADE OF THE UNITED KINGDOM AND THE UNITED STATES.

Average.	World Imports in Millions of £'s.	United Kingdom.		United States.		World Exports in Millions of £'s.	United Kingdom.		United States.	
Years.		Imports in Millions of £'s.	Percentage.	Imports in Millions of £'s.	Percentage.		Exports in Millions of £'s.	Percentage.	Exports in Millions of £'s.	Percentage.
1910 1911 1912	£3,508	£595	17%	£334	9·5%	£3,233	£457	14%	£434	13·4%
1920 1921 1922	£5,975	£1,196	20%	£932	17%	£5,300	£919	17·3%	£1,398	26%

It is clear from Table II that the United Kingdom continues to maintain her percentage of the world's trade, but that the United States, her most formidable rival, has surpassed her recently in the export trade. The position in the export trade, however, tends steadily to improve in Britain's favour as she gradually recovers from the strain of the War. The average foreign trade of the British Isles previous to 1914 was £28 per head of population, that of the United States £8½; the averages for the years 1921, 1922, 1923 were £45, and £16 respectively. Britain had in 1923 and 1924, regained the premier position in the export trade; and, doubtless, will keep it. It must be remembered that the first task of the American manufacturer is to supply the great and expanding home market, and that, therefore, there is less need of foreign markets than is the case with Britain, whose population is more largely industrial. The United States has a tremendous capacity for capital accumulation, but has great opportunities within its own borders for the use of that capital; whereas Britain's accumulated capital has less opportunities in so small an area and must in large degree seek foreign investment.

Table III shows that 75 per cent of Britain's imports are food products and materials (largely raw) for manufactures. British agriculture furnishes only about a quarter of the wheat and three-fifths of the meat consumed in the country. The large import of mining products is due to the failure or deficiency of home supplies. Of textile materials all the raw cotton, most of the wool, and much of the flax is imported. The imports of manufactured goods, which are approximately 25 per cent of the total import, are due to Britain largely confining herself to the production of high quality goods and the importing of the cheaper grades; and to the want of sufficient skill, technique, and sometimes cheap labour, to supply the home demand for the manufactured products of such industries as the chemical and silk. It is obvious from the imports that Britain is highly industrialized, and that her existence depends upon her commerce.

British exports of foodstuffs and raw materials consist largely of highly prepared foods and drinks; and of coal, which makes up more than three-quarters of the exports of raw materials, and is of prime importance as an outward cargo, since most British imports are bulky, while the chief exports are the contrary. Manufactured goods form approximately 80 per cent of the total exports, and emphasize the fact that Britain's wealth derived from overseas markets is conditioned by the skill and organizing powers of her workers.

TABLE III.—NATURE OF THE IMPORT AND EXPORT TRADE OF THE UNITED KINGDOM, 1913 AND 1923.

Commodities.	1913.				1923.			
	Imports. Value c.i.f.		Exports. Value f.o.b.		Imports. Value c.i.f.		Exports. Value f.o.b	
	£ Millions.	£ Millions.	£ Millions.	£ Millions.	£ Millions.	£ Millions.	£ Millions.	£ Millions.
I. *Food and Tobacco*—								
Grain and Flour	85·5	290·2	3·5	32·6	102·7	510·5	6·6	44·4
Meat, including animals . .	56·7		1·2	*Percentage of Home Produce,* 6%	125·7		1·6	*Percentage of Home Produce,* 6%
Other food:		*Percentage,* 38%				*Percentage,* 46%		
(*a*) Non-dutiable	81·2		24·4		149·5		29·3	
(*b*) Dutiable .	58·7				116·1		—	
Tobacco . .	8·0		3·3		16·4		6·9	
II. *Raw and mainly unmanufactured goods*—								
Coal, Coke, etc.	0·03	281·8	53·6	70·0	0·02	325·0	99·8	130·8
Other non-metallic mining products . . .	—		—		5·6		1·8	
Iron Ore, Scrap Iron, and Steel	7·4		0·4		7·8		·5	
Other metallic ores	10·2		0·1		12·4		2·1	
Timber . . .	33·8		0·3	*Percentage of Home Produce,* 13%	47·7		0·5	*Percentage of Home Produce,* 17%
Cotton . . .	70·6	*Percentage,* 37%	—		93·5	*Percentage,* 30%	1·6	
Wool . . .	37·7		4·6		50·3		9·75	
Other Textile Materials . . .	19·8		0·4		11·9		0·6	
Oil Seeds, Nuts, Oil . . .	41·6		4·4		44·4		5·6	
Hides . . .	15·0		1·8		16·8		2·3	
Paper-making materials . . .	5·8		0·9		11·5		1·6	
Rubber . . .	—		—		12·3		0·1	
Miscellaneous .	39·8		3·0		10·6		4·3	
III. *Articles wholly or mainly manufactured*—								
Coke and manufactured Fuel	—		—		0·2	257·4	10·1	580·0
Iron and Steel .	15·2	193·6	54·3	411·3	13·8		76·2	
Other metals . .	32·1		13·2		25·6		14·5	
Hardware and Cutlery . .	7·4		8·0		7·1		7·4	
Electrical goods	1·6		5·4		2·4		10.2	
Machinery . .	7·3		37·0		9·3		44·5	
Ships (new) . .	0·03		11·0		—		—	
Woodwork . .	3·6		2·0		4·6		1·8	
Yarns and Textile Fabrics . .	46·9		181·8		57·6		265·7	
Wearing Apparel	6·0		16·4		16·6		26·4	
Chemicals . .	13·0		22·0	*Percentage of Home Produce,* 81%	13·5		25·7	*Percentage of Home Produce,* 77%
Leather manufactures . .	13·4	*Percentage,* 25%	5·6		11·9	*Percentage,* 24%	5·8	
Glass, Earthenware . . .	4·5		5·2		7·6		12·3	
Paper . . .	7·6		3·6		13·6		8·8	
Vehicles (including Locomotives, Ships and Aircraft) .	8·3		11·3		7·5		27·8	
Oils, Fats, and Resins (manufactured) . .	—		—		34·5		7·0	
Rubber (manufactures) . .	—		--		5·0		5·3	
Miscellaneous Manufactures .	26·5		34·2		26·6		30·4	
IV. *Animals not for Food* . . .	—	—	—	—	—	1·5	—	1·4
V. *Parcel Post, Non-Dutiable Articles* . .	—	3·1	—	11·3	—	3·9	—	10·7
Total Exports of Foreign and Colonial Merchandise (Entrepôt trade) . . .	—	—	—	109·6	—	—	—	118·6
Total Imports and Exports . .		768·7		634·8		1098·3		885·9

The value of imports, exports, and re-exports for 1924 were—Imports: £1,279,845,000; Exports (British): £795,365,000; Exports (Foreign and Colonial): £140,149,000. Since 1st April, 1923, the trade between Great Britain and Northern Ireland, on the one hand, and the Irish Free State on the other hand, has been considered as foreign trade. For 1924, the effect has probably been to increase British imports by £40,000,000, exports by £42,000,000, and re-exports by £11,000,000 beyond what they otherwise would have been.

TABLE IV.—RELATION OF THE TRADE OF THE UNITED KINGDOM WITH THE EMPIRE AND WITH FOREIGN COUNTRIES.

	Percentage of Imports from the Empire (Value).	Percentage of Exports to the Empire (Value).	Percentage of Imports from Foreign Countries (Value).	Percentage of Exports to Foreign Countries (Value).
Average 1911, 1912, 1913 . . .	25%	33%	75%	67%
Average 1921, 1922, 1923 . . .	31%	34%	69%	66%

Table IV indicates the increasing importance of the Empire's trade with the Mother Country, and the need for the closest of bonds to connect the Mother and the Daughter Lands. Trade with foreign countries is obviously vital to Britain. It is highly important, however, to note that the trade with overseas British citizens *per capita* is greater than the trade with the citizens of foreign countries *per capita*.

Table V shows the importance of British trade with the United States, India, Germany, France, Australia, Canada, South Africa, New Zealand, Holland, Belgium, Italy, Denmark, Russia (normally), Japan, China, Argentina, Brazil, and Egypt. The decline in imports from Europe since the War is primarily due to the unstable conditions in Russia and the temporary crippling of Germany.

The striking fact of Table VI is the great dependence of Britain on foreign food, textile materials, and minerals.

Britain needs, in the future, to develop more her position in the American and Far-Eastern markets; to foster the economic recovery of Europe; to make the Empire self-contained in the major staples; and to continue her policy of concentration on goods of the highest quality.

IMPORTS OF THE BRITISH ISLES.

PRODUCTS FROM THE BALTIC

Dairy Produce
Bacon
Fish
Eggs
Timber
Flax
Tow
Ice
Skins
Matches

PRODUCTS FROM NORTH AMERICA

Timber
Cattle
Meat
Dairy Produce
Eggs
Leather & Hides
Furs
Fish
Wheat
Raw Cotton
Maize
Oats
Paper
Phosphates
Tobacco
Fruits
Machinery
Motors
Textiles
Petroleum
Copper
Lead
Zinc
Nickel
Silver
Glass
Electrical Goods
Asbestos
Graphite
Rubber Goods
Clocks & Watches

PRODUCTS FROM CENTRAL AND SOUTH AMERICA AND THE WEST INDIES

Rubber
Cocoa
Coffee
Raw Cotton
Tobacco
Sponges
Copra
Cane Sugar
Tropical Woods
Tropical Fruits
Cochineal
Rum
Dyes
Tanning Materials
Silver
Petroleum
Jute
Hemp
Oil Seeds
Spices
Asphalt

PRODUCTS FROM SOUTH AMERICA

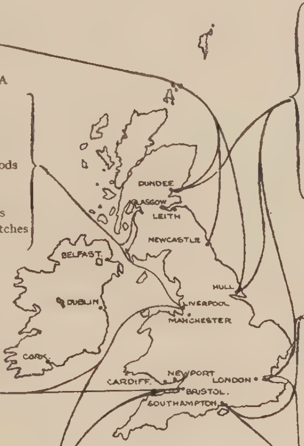
Meat (Frozen &
Wheat (Chilled)
Maize
Tallow
Hides & Skins
Raw Cotton
Timber
Tea
Copper
Wool
Coffee
Sugar (Cane)
Cocoa
Oil Seeds &
Silver [Nuts
Nitrates
Fruits
Rubber
Petroleum
Precious
Stones
Beans
Guano

PRODUCTS FROM TROPICAL EAST AND WEST AFRICA

Palm Oil
Ivory
Rubber
Gum
Cabinet Woods
Spices
Cocoa
Coffee
Raw Cotton
Timber
Cane Sugar
Oil Seeds
Oil Nuts
Gold
Tin
Feathers

PRODUCTS FROM SOUTH AFRICA

Mohair
Ostrich Feathers
Wool
Hides
Diamonds
Gold
Copper
Tea
Wine
Fruits



PRODUCTS FROM SOUTHERN EUROPE AND NORTH AFRICA

Fruits
Wines
Olive Oil
Raw Silk & Silk
Leather [Goods
Cork
Alfa Grass
Mercury
Grain
Sulphur
Flavourings
Tobacco
Cotton
Wheat
Hides & Skins
Asbestos
Sponges
Graphite
Iron Ore
Copper
Lead
Zinc

PRODUCTS FROM AUSTRALASIA

Mutton
Timber
Wheat
Flour
Hemp
Fruits
Wool
Butter
Tallow & Hides
Kauri Gum
Wine
Copra
Gold
Silver
Tin
Copper
Skins

PRODUCTS FROM S.E. AND S.W. ASIA

Fruits
Nuts
Rugs
Mohair
Petroleum
Dates
Tanning Materials
Wheat
Rice
Maize
Jute
Cotton
Spices
Cane Sugar
Oil Seeds
Coffee
Tea
Indigo
Timber
Precious Stones
Ivory
Wool
Gold
Plumbago
Tobacco
Tin
Skins
Hides
Leather
Gutta Percha
Rubber
Graphite
Pulses

PRODUCTS FROM WEST AND CENTRAL EUROPE AND RUSSIA

Dairy Produce
Bacon & Eggs
Beet Sugar
Timber
Wheat
Forest Products
Fur
Ice
Margarine
Paper
Wood Pulp
Flour
Wine
Iron Goods
Iron Ores
Manganese
Zinc
Tallow
Hides
Textiles
Machinery
Leather Goods
Toys
Musical Instruments
Glass
Chemicals & Dyes
Matches
Silk Goods
Porcelain
Earthenware
Platinum
Graphite
Clocks
Watches

PRODUCTS FROM FRANCE

Silk and Silk Goods
Gloves
Ribbons
Fancy Goods
Lace & Embroidery
Cotton & Woollen Goods
Fruits
Dairy Produce
Wine
Brandy
Eggs
Beet Sugar
Vegetables

PRODUCTS FROM CHINA AND JAPAN

Tea
Raw Silk & Silk Goods
Rice
Sugar
Beans
Bristles
Toys
Matches
Straw Plait

TABLE V.—CHIEF COUNTRIES TRADING WITH THE UNITED KINGDOM.

Countries.	Percentage of Imports from		Percentage of Exports to	
	1913.	1923.	1913.	1923
	(Value.)	(Value.)	(Value.)	(Value.)
British Empire (Total)	25·0	31·0	33·0	34·0
India	6·4	4·7	11·3	11·4
Australia	4·9	6·4	6·0	7·8
Canada	4·0	5·4	4·3	3·5
British South Africa	3·9	3·4	3·9	3·4
New Zealand	2·6	4·7	1·9	2·0
European Countries (Total)	39·0	29·0	38·0	38·0
France	6·0	4·9	6·4	7·8
Germany	9·5	6·0	9·5	6·0
Holland	3·1	3·4	3·2	4·8
Belgium	3·0	2·4	3·3	4·2
Italy	1·0	1·1	2·4	2·5
Russia	5·2	0·8	4·4	1·7
Sweden	1·8	1·9	1·4	1·7
Denmark	3·1	4·0	1·0	1·6
Spain	1·9	1·9	1·4	1·6
Norway	0·9	1·1	1·1	1·6
Non-European Countries (Total)	36·0	40·0	29·0	28·0
United States	18·4	22·2	9·4	9·2
Japan	0·6	0·8	2·3	2·8
China	0·6	1·0	2·4	2·9
Argentina	5·5	5·6	3·7	2·9
Egypt	2·8	3·1	1·6	2·0
Brazil	1·3	0·8	2·1	1·4

TABLE VI.—SOURCES OF THE CHIEF BRITISH IMPORTS

Imports.	Average Percentage Imported (Value) of Total Supply.	Countries of Origin.
I. *Food, Drink, and Tobacco*—		
Wheat and Flour	75–80	The United States, Canada, India, Argentina, Australia, Russia (normally), Egypt.
Maize	100	Argentina, Roumania, South Africa, the United States (greatly decreasing).
Oats	—	Canada, the United States, Argentina.
Pulses	—	The United States, Canada, China, Turkey, Egypt.
Rice	100	Burma, Bengal, Siam, China, Java.
Barley	—	Russia (normally), India, the United States, Turkey, Roumania, Canada.
Rye	—	The United States, Canada.
Dairy Produce and Eggs	—	Denmark, the Irish Free State, Siberia (normally), France, Sweden, Holland, New Zealand, Australia, Canada, the United States, Switzerland, China, Egypt, Italy.
Fish	40–45	Canada, the United States, Norway, Holland, France, Italy, Portugal, Japan, Denmark.
Beef		Argentina, Australia, the United States, New Zealand, Uruguay, Denmark, the Irish Free State.
Mutton		New Zealand, Argentina, Australia, Uruguay, Holland.
Bacon, Pork, Hams		The United States, Canada, China, Holland, Denmark, the Irish Free State.
Living Animals		The United States, Canada, Holland, the Irish Free State.
Poultry and Game		Australia, Belgium, Russia, the United States, France, Canada, New Zealand.
Fruits—Tropical	100	Canary Islands, East and West Indies, Central America, and northern South America.
Sub-tropical		" Mediterranean " countries.
Temperate	—	Canada, the United States, Australia, Normandy.
Sugar—Beet	Nearly 100	Germany, France, Holland, Czecho-Slovakia.
Cane	100	United States, Java, Canada, Cuba, Mauritius, British West Indies, Peru, British Guiana, Queensland.
Maple		
Spices and Flavourings.	Nearly 100	East and West Indies, Zanzibar, India, Central America, Mexico, Philippine Islands, Malaya, France, Italy, Mauritius, Madagascar, Seychelles, China, Siam.
Tea	100	Ceylon, Assam, China, Java, Natal.
Coffee	100	Brazil, Costa Rica, British East Africa, West Indies, West Africa.
Cocoa	100	Gold Coast Colony, British West Indies, Nigeria, Ecuador, Brazil, São Thome, Java.
Wine	100	Portugal, France, Spain, Italy, Germany, South Africa, Australia, Hungary.
Spirits	—	British West Indies, British Guiana, France, Holland.
Ice	—	Scandinavia.
Tobacco and Snuff	Nearly 100	The United States, British India, Greece, Turkey, Russia, Cuba, the Philippine Islands, Mexico, Borneo, Egypt, Canada, S. Africa.

TABLE VI.—SOURCES OF THE CHIEF BRITISH IMPORTS (*contd.*)

Imports.	Average Percentage Imported (Value) of Total Supply.	Countries of Origin.
I. *Food, Drink, and Tobacco* (*contd.*)—		
Vegetables	—	North Sea countries and France.
Margarine	—	Holland.
Oleo-Margarine	—	Argentina, the United States, Australasia.
II. *Raw Materials* (*mainly*)—		
Textiles—Cotton	100	The United States, Egypt, British India, Peru, Brazil, Sudan, Nigeria.
Wool	80–88	Australia, New Zealand, South Africa, British India, Argentina, Uruguay.
Flax	—	Russia, Holland, France, Baltic Republics, Belgium.
Jute	100	India, the Philippines, Central America.
Silk	100	China, Japan, Italy, France, India.
Hemp	—	New Zealand, the Philippine Islands, Italy, Russia, Central America, India.
Rubber	100	Malaya, India, Ceylon, East Indies, Brazil, Belgian Congo, Peru.
Furs	Nearly 100	Canada, Siberia, the North Pacific Islands.
Timber	90–97	The United States, Canada, Russia, Sweden, Norway, Finland, France, East Indies, India, Central America, West Indies, Brazil, South Africa, Australia, Germany, Burmah.
Oils, Oil Seeds, Oil Nuts	Nearly 100	Nigeria, Straits Settlements, Gambia, Sierra Leone, Java, India, Ceylon, West Indies, Egypt, the United States, Argentina, Brazil.
Petroleum and Paraffin	90–95	The United States, Mexico, Russia, Burmah, Persia, Roumania, Iraq, East Indies.
Hides and Skins	—	East Indies, Holland, Italy, Belgium, Argentina, South Africa, Australia, Brazil, Russia, France, Germany, India, the United States, New Zealand.
Tanning and Dyeing Materials	—	East Indies, France, Turkey, Italy, Natal, Argentina, India, West Indies.
Feathers	—	South Africa, Algeria, Australia, Norway, Iceland.
Ivory	—	Africa.
Sponges	—	The Levant and the West Indies.
Gums	—	India, New Zealand, North Africa.
Paper-making Materials.	—	Norway, Sweden, Canada, North Africa.
Minerals—		
Iron Ore	20–30	Spain, Sweden, Algeria, Greece.
Copper	95	Spain, South Africa, the United States, Australia, Chile, Peru.
Lead	95	Spain, Australia, the United States, Germany, New Zealand, France.
Manganese	100	British India, Chile, Brazil, Turkey, Russia.
Zinc	95	Belgium, Germany, the United States, Italy, Greece, Tunis, Spain, Australia.
Tin	90	Malaya, Bolivia, Nigeria, East Indies.
Mercury	100	Spain (Almaden), Italy.
Platinum	100	Russia, Colombia.
Nickel	100	Canada, New Caledonia, the United States.
Gold	Nearly 100	South Africa, Australia, Canada, West Africa.
Silver	95	The United States, Mexico, Australia, Germany.

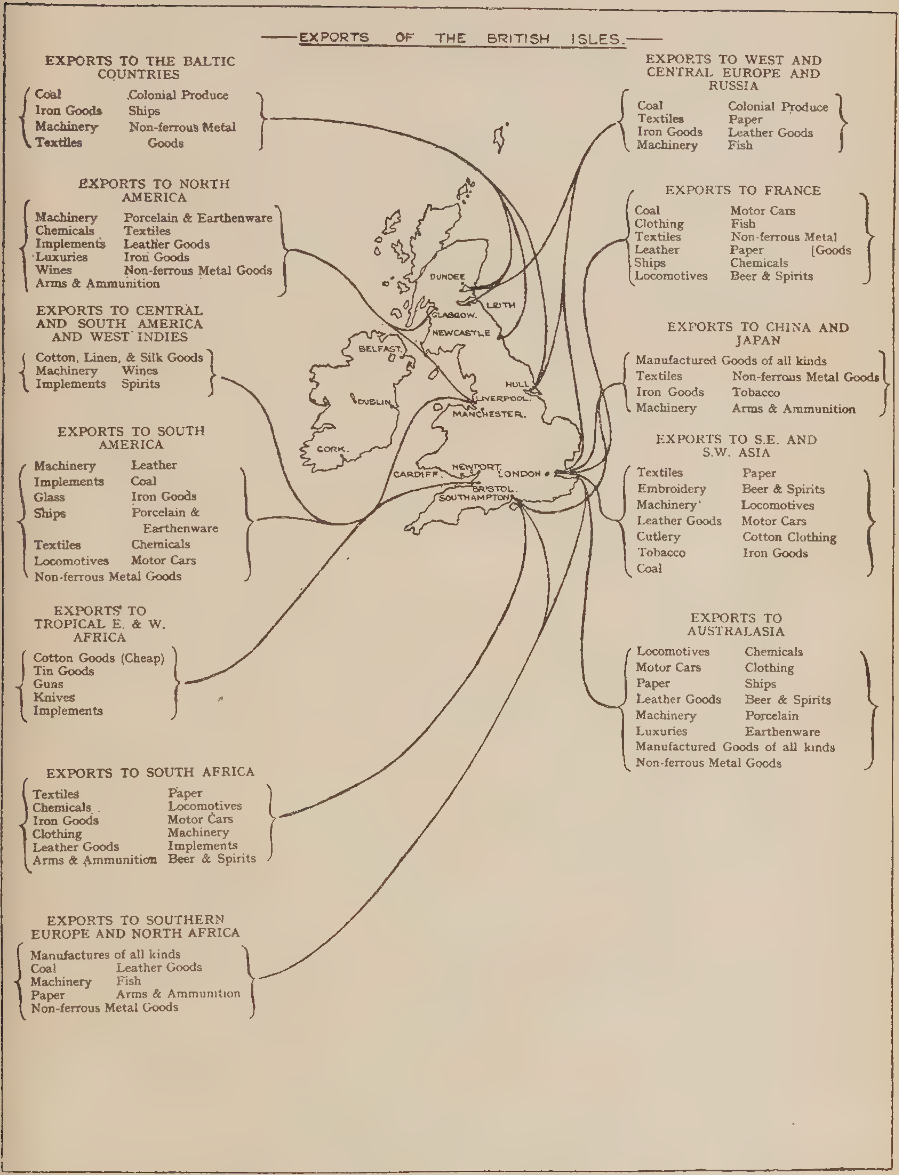
TABLE VI.—SOURCES OF THE CHIEF BRITISH IMPORTS (*contd.*)

Imports.	Average Percentage Imported (Value) of Total Supply.	Countries of Origin.
II. *Raw Materials (mainly) (contd.)*—		
Asbestos	100	Canada, Italy.
Graphite	100	Ceylon, Germany, the United States, Spain.
Asphalt	100	Trinidad, Germany, France, Italy, Switzerland.
Diamonds and other Precious Stones	100	South Africa, Brazil, Burmah, Ceylon, Colombia, Australia, Persian Gulf.
Sulphur	100	Italy.
Nitrates	100	Peru, Chile, Norway.
Guano	100	Peru.
Phosphates	100	The United States
III. *Manufactured Articles*—		
Cotton Yarns and Manufactures	10–15	France, Germany, the United States, Japan.
Woollen Yarns and Manufactures	10–15	France, Germany, the United States.
Machinery	—	Germany, the United States, France.
Leather Goods and Gloves	15–18	The United States, Germany, France, Belgium.
Motors	—	France, the United States, Italy.
Toys and Musical Instruments.	—	Germany, France, Japan, Switzerland.
Rubber Goods	—	The United States.
Chemicals and Dyes	—	Germany, Belgium.
Clocks and Watches	—	The United States, Switzerland, Germany.
Scientific Instruments	—	Germany, France.
Iron Goods	3–6	Germany, the United States, Belgium.
Glass	—	Germany, Belgium, Czecho-Slovakia, the United States, Holland.
Paper and Cardboard	—	Sweden, Norway, Germany, Newfoundland.
Electrical Goods	—	The United States, Germany, France.
Jute Goods	—	India.
Matches	—	Sweden, Norway, Japan, Belgium, Czecho-Slovakia.
Straw Plaiting	—	Japan, China.
Silk Goods	—	Japan, China, France, Switzerland, Italy, Germany.
Starch	—	United States, Japan.
Clothing	—	France, Germany.
Porcelain and Earthenware	25–28	France, Belgium, Germany.

BRITISH PORTS.—The tendency of British trade is to concentrate more and more upon a few great ports of entry and departure: thus the twelve leading ports—London, Liverpool, Hull, Manchester, Glasgow, Bristol, Newcastle, Cardiff, Southampton, Leith, Grimsby, and Dover—handle approximately 80 per cent of the total trade. These ports accommodate the large and fast steamships; have adequate railways and road facilities at the quays; are provided with modern appliances and with labour-saving machinery; and have ample warehouse accommodation for goods. It is noticeable that the ports with great industrial hinterlands, such as Liverpool and Hull, have a greater value of exports than of imports, and that the value of the trade of a port is often not in proportion to its tonnage. Southampton ranks high in tonnage owing to its large

TABLE VII.—CHIEF BRITISH EXPORTS.

Exports.	Chief Receiving Countries.
Coal	France, Italy, Germany, Denmark, Holland, Sweden, Spain, Egypt, Argentina, Norway, Brazil, Russia, Portugal, coaling stations, and bunker coal.
Cotton Yarn . . .	Germany, Holland, Switzerland, India, Japan, Turkey.
Cotton Goods . . .	India, China, Turkey, Egypt, West Indies, South America, West and Central Africa, East Indies, Japan, Australia, Canada, the United States, Spain, Italy, France, the Balkan countries, Switzerland.
Woollen Tops and Yarns	Germany, Japan, Sweden, Denmark, Italy, Spain.
Woollen Goods . .	Canada, Germany, Australia, France, Belgium, the United States, Argentina, Japan, New Zealand, South Africa, Norway, Sweden, Russia, Baltic Republics, Denmark, Austria, Hungary.
Flax and Hemp Yarn .	Germany, Belgium, the United States, Spain.
Linen Goods . . .	The United States, Australia, Canada, Cuba, India, Argentina.
Silk Goods . . .	The United States, France, Holland, India.
Jute Goods . . .	The United States, Argentina, Canada, Brazil.
Iron Goods . . .	The United States, France, Germany, India, Australia, Japan, Argentina, New Zealand, Holland, Belgium, China, Brazil.
Machinery . . .	The United States, France, Germany, India, Japan, Australia, Canada, South Africa, Russia, Belgium, Italy, Argentina.
Porcelain and Earthenware.	The United States, Canada, Australia, Argentina, New Zealand.
Clothing	South Africa, the United States, Australia, Holland, New Zealand, Canada, Norway, Denmark, Belgium, India.
Chemicals . . .	India, Australia, South Africa, France, Spain, Argentina, Belgium.
Ships	Norway, France, Belgium, Brazil, Holland, Sweden, Australia, Spain, Argentina.
Beer and Spirits . .	Australia, Canada, East Indies, South Africa, Belgium, India.
Locomotives, Motor-cars	India, Argentina, Brazil, Holland, France, South Africa, Australia.
Paper	India, Australia, South Africa, France.
Leather Goods. . .	South Africa, Holland, France, Belgium, Russia, the United States, Germany, Australia, New Zealand.
Fish	Germany, Poland, Russia, Spain, Italy.
Non-ferrous Metal Goods	The United States, France, Germany, Holland, Italy, Russia, Canada, Sweden, Australia, Argentina, Brazil, Japan.
Tobacco and Snuff . .	China, Malaya, India.
Arms and Ammunition .	India, Australia, Spain, South Africa, Japan, the United States.



EXPORTS OF THE BRITISH ISLES.

EXPORTS TO THE BALTIC COUNTRIES

Coal
Iron Goods
Machinery
Textiles
Colonial Produce
Ships
Non-ferrous Metal Goods

EXPORTS TO NORTH AMERICA

Machinery
Chemicals
Implements
Luxuries
Wines
Arms & Ammunition
Porcelain & Earthenware
Textiles
Leather Goods
Iron Goods
Non-ferrous Metal Goods

EXPORTS TO CENTRAL AND SOUTH AMERICA AND WEST INDIES

Cotton, Linen, & Silk Goods
Machinery
Implements
Wines
Spirits

EXPORTS TO SOUTH AMERICA

Machinery
Implements
Glass
Ships
Textiles
Locomotives
Non-ferrous Metal Goods
Leather
Coal
Iron Goods
Porcelain & Earthenware
Chemicals
Motor Cars

EXPORTS TO TROPICAL E. & W. AFRICA

Cotton Goods (Cheap)
Tin Goods
Guns
Knives
Implements

EXPORTS TO SOUTH AFRICA

Textiles
Chemicals
Iron Goods
Clothing
Leather Goods
Arms & Ammunition
Paper
Locomotives
Motor Cars
Machinery
Implements
Beer & Spirits

EXPORTS TO SOUTHERN EUROPE AND NORTH AFRICA

Manufactures of all kinds
Coal
Machinery
Paper
Non-ferrous Metal Goods
Leather Goods
Fish
Arms & Ammunition

EXPORTS TO WEST AND CENTRAL EUROPE AND RUSSIA

Coal
Textiles
Iron Goods
Machinery
Colonial Produce
Paper
Leather Goods
Fish

EXPORTS TO FRANCE

Coal
Clothing
Textiles
Leather
Ships
Locomotives
Motor Cars
Fish
Non-ferrous Metal Goods
Paper
Chemicals
Beer & Spirits

EXPORTS TO CHINA AND JAPAN

Manufactured Goods of all kinds
Textiles
Iron Goods
Machinery
Non-ferrous Metal Goods
Tobacco
Arms & Ammunition

EXPORTS TO S.E. AND S.W. ASIA

Textiles
Embroidery
Machinery
Leather Goods
Cutlery
Tobacco
Coal
Paper
Beer & Spirits
Locomotives
Motor Cars
Cotton Clothing
Iron Goods

EXPORTS TO AUSTRALASIA

Locomotives
Motor Cars
Paper
Leather Goods
Machinery
Luxuries
Manufactured Goods of all kinds
Non-ferrous Metal Goods
Chemicals
Clothing
Ships
Beer & Spirits
Porcelain
Earthenware

passenger trade, but in value is exceeded by ports with lesser tonnage, and the coal trade of Cardiff and Newcastle gives these ports a high tonnage which is no index of its value.

London and Liverpool are predominantly the two chief ports. Liverpool leads in exports, London in imports. Both trade with the whole world, but specialize—London in the Eastern trade, Liverpool in the North American trade. Together, they carry on 75 per cent of the entrepôt trade, and approximately 55 per cent of the whole of the foreign trade of Britain. London's hinterland is the whole of England, and she has within her own confines a great population. Her imports are, therefore, food products, raw materials, and manufactured goods, and her exports largely manufactured goods. Liverpool's hinterland includes industrial Lancashire, Yorkshire, and the Midlands; and she exports more British manufactures and produce than any other port. Cotton is her predominant import. Hull is largely engaged in the North Sea and Baltic trade; Bristol, in the West Indian, Irish, and South American trade; Southampton, in the South African trade; Cardiff and Newcastle, in the coal and iron trade; Leith and Dover, in the Continental trade; Glasgow, in the North American trade; Grimsby, in the fishing trade; while Manchester, though her main interest is cotton, has become a great distributing centre of food products, raw materials, and manufactured goods for industrial England.

In conclusion, it is fitting to state that the prosperity of Britain's industry and commerce rests on her historic growth, her sea-power, the character of her people, her stable government, her slow evolutionary process of change, her natural wealth, and her commanding position. Other nations have, in the nineteenth and twentieth centuries, become commercial and industrial at a rate more rapid than that taken by the British races, and are now Britain's keen competitors. Yet, Britain's future is assured if all the energy, mental and material, which she possesses, be fully used by her people.

> "Gird on thy sword, O Man—thy strength endue,
> In fair desire thine earth-born joy renew;
> Live thou thy life beneath the making sun,
> Till Beauty, Truth, and Love in thee are one."
>
> —*Robert Bridges.*

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